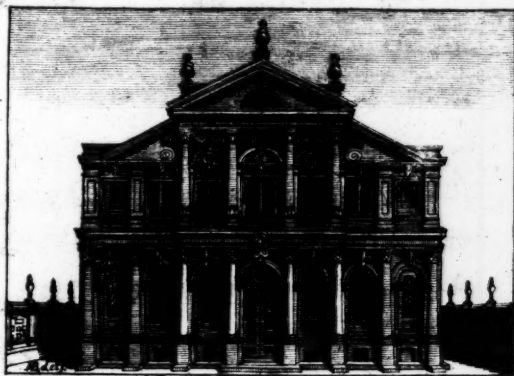


A N
EXAMINATION
 O F
Dr. BURNET'S
Theory of the Earth.
 T O G E T H E R
 W I T H S O M E R E M A R K S
 O N
Mr. WHISTON'S
New Theory of the Earth.

By **J. O. KEILL A.M. Coll. Ball. Ox.** *A Second Edition was printed at London by J. O. Keill in 1734.*



O X F O R D,
 Printed at the THEATER 1698.

EXAMINATION

OF

DEGREES

Theology of the Faith

TOGETHER

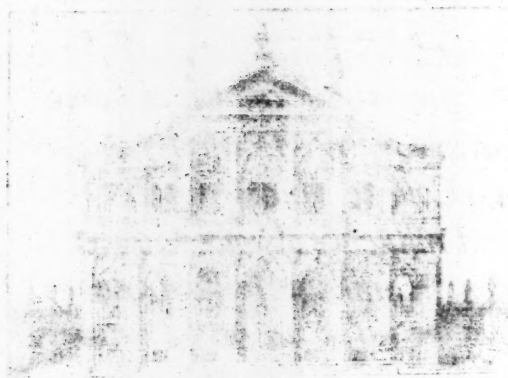
WITH SOME REMARKS

ON

MR. WHISTON'S

NEW THEORY OF THE BIBLE

OF JOSEPH L. A. DE LAUNAY



T O
THE REVEREND
D^r. M A N D E R
THE
WORTHY MASTER
O F
BALLIOL COLLEGE
I N
O X F O R D.

REVEREND SIR,

T HIS *small Treatise be-
ing the Product of some
leasure hours, I happily enjoy
in a College that is under the
kind influence of your Govern-
ment, thinks it self obliged to*

a 2

wait

wait upon you, before it dares venture one step further into the world. Its dress I freely own is mean; Nevertheless since the designe of it is no other than to shew, that true Philosophy doth not contradict the Scriptures, I am inclined to hope it will find a favourable acceptance among such as have any Concern or Zeal for the advancement of the one, or the security of the other.

The Principles on which I have grounded my Arguments in the following discourse being Mathematical, it doth more peculiarly belong to You, whose prudence in so Industrious

ously promoting the Mathematical Sciences, both by your Direction and Encouragement I cannot sufficiently Commend, when I consider what vast improvements have been made, and how many Errors of former Philosophers have been detected by applying Geometry to Natural Philosophy.

I am sensible Sir, how unpleasant it would be if I should Address my self to You in the usual stile of Dedications. A prudent Zeal for the Authority of Scriptures, an Hearty Concern for the Rights of the Church, a Tender Care and Unwearied Industry in Pro-

a 3 moting

moting the Discipline, Learning, and Interest of an Antient Society, are Virtues which oblige the World to pay You those Praises, which your Modesty will not suffer you to receive. We who live under the Advantages of these Excellent Qualifications in a Governour, cannot but be sensible of the Obligations we have to be thankful for them; and indeed the desire of Expressing my Gratitude, for these Common and many other Particular Favours You have been pleased to bestow on me, was the great motive of my presuming to Inscribe this Discourse

*course to your Name ; which
I desire may be accepted as the
result of Duty and Grati-
tude from,*

WORTHY SIR,

Your most Faithful

And most Obliged

Humble Servant

JO. KEILL.

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ERRATA.

Correcta.

P. 30. l. 4. for vulgar read vulgar opinion. p. 30. l. 31. for move read remove. p. 48. l. 8. for of read o'. p. 57. l. 1. for things read springs. p. 61. l. 9. dele not. p. 123. 123. for GO read CO.

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Ubiq AN *Veritatem*
EXAMINATION
Homines OF *Barbari*
D. BURNET'S
Theory of the Earth.

The Introduction.

WHAT *Plutarch* particularly proves of the *Stoicks*, that they spoke more improbabilities than the Poets, may be extended to a great part of Philosophers, who have maintained opinions more absurd than can be found in any of the most Fabulous Poets, or Romantick Writers. The one as well as the other fancied that their character did oblige them to say things, which were not common or obvious to vulgar capacities, and therefore scorning the Instructions of sense
A and

The Introduction.

and reason, they only cultivated their own wild imaginations, which seldom produce any thing but what is extravagant and unaccountable. This will soon appear to any who will be at the pains to examine either the Ancient or Modern Philosophers. To begin with the Ancients.

Which of the Poets did ever maintain so ridiculous an opinion, as that it is impossible for Bodies to move? And yet there have been Philosophers (for so they were pleased to stile themselves) who have brought arguments to prove motion to be a thing altogether impossible in nature, and have pretended that these their arguments almost reached the force of demonstration. Is the Fable of *Leda's* being first turned into a Swan, and afterwards placed in the Heavens as a fixed Star, more improbable than the opinion of *Anaxagoras*, that the *Circumambient Æther* being of a fiery substance by the vehement force of its whirling about did tear stones from the earth, and by its own power set them on fire and established them as Stars in the Heavens? *Diogenes* another Philosopher said that the stars were like pumice stones, and that they were the breath-

breathings of the world. But *Xenophanes* the founder of the *Eleatick* Sect says they are composed of inflamed Clouds; which in the day time are quenched, and in the night are kindled again, and that the rising and setting of the stars, is nothing else but the kindling and quenching of them. *Anaximander* thought the Sun did very much resemble the nave of a Chariot wheel, which is hollow and full of fire, the fire of which appears to us through its mouth, as by a pipe that is burning. And *Anaximenes* said that when the Sun was eclipsed, the fiery mouth of it was stopp'd and hinder'd from perspiration. *Heraclitus* tells us that the eclipse of the Sun was after the manner of the turning of a boat, when the concave as to our sight appears uppermost, and the convex heithermost. Another Philosopher said, that when the Sun was eclipsed, it was extinguished. These indeed are strange notions, but yet they will seem much stranger if we consider that these men lived after *Thales*, who had foretold an eclipse of the Sun by his knowledge that the Moon was to be at such a time in a direct line betwixt him and it. Such an aversion it seems these Philosophers

had to build upon other mens observations, that they would rather speak unsufferable nonsense, than be at the pains to consider what was observed before them by wiser men than themselves.

But who without indignation can hear the above mentioned *Xenophanes* maintain, that the earth was founded and rooted in an *infinite depth*, or *Epicurus* the *World-maker* assert, that the Earth was in the shape of a Drum, and that we dwell upon the plain surface of it, tho' long before either of their times, it was demonstrated by the Mathematicians, that the Earth was of a spherical figure, and they had given rule to take the dimensions of it? The same *Epicurus* affirms, in contradiction both to sense and reason, that the sun, Moon, and Stars are no bigger than they appear to us to be, and for an thing that he knew to the contrary the Stars might be kindled in the East Quarter and extinguished in the West, or that there might be a new production of Stars every day, so that every day there arose a new Sun. I am sure a Blind man, who had never seen either Sun or Stars, could not have given a worse account of them, than this Philosopher has done; and yet
 blind with

The Introduction.

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with an unpardonable boldness he pretended to tell us, how the World was made, when it is plain he knew not what it was.

He who desires to know more of the wild notions of the old Philosophers, may consult *Diogenes Laertius*, or *Plutarch's* Books of the sentiments of Philosophers.

But perhaps our Moderns will say, that these indeed were the ridiculous fancies of the old whimsical Philosophers, and it is no great matter what they thought, but that now in this Learned and Inquisitive Age, they have at last found out the true and solid Philosophy. They do now perceive the intimate essence of all things, and have discovered Nature in all her works, and can tell you the true cause of every effect, from the sole principles of matter and motion. If you will believe them, they can inform you exactly, how God made the World; for they do now comprehend the greatest mysteries in nature, and understand the Oeconomy of living Bodies: Nay they understand also very exactly the Theory of the Soul, how it thinks, and by what methods it operates on the Body, and the Body on it.

These indeed are great discoveries, and might well demand our esteem and admiration, if they were real. But that we may see how well they deserve such a Character, I will here set down some of their sentiments, both as to the Intellectual and Natural System.

Spinoza pretends to demonstrate that there is but one individual Substance in the Universe, and that all particular beings are different modifications of the same substance. Another Philosopher, viz. *Dr. More*, will have Souls, besides the three dimensions which belong to Bodies, to have a fourth, which he calls the Souls *essential spissitude*, by which it can contract or dilate it self when it pleases. *Mr. Hobbs* thinks Incorporeal Substances a flat contradiction, and that therefore it is altogether impossible there should be any such. But a new * Philosopher has much out-done any I have yet mentioned, in a Book lately Printed concerning Reason; there he assures us that there is but one universal Soul in the World, which is omnipresent and acts upon all particular organized Bodies, and makes them produce actions more or less perfect in proportion to the good disposition of their Organs, so that

* *Dr. Burthogge.*

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that in Beasts, that Soul is the principle of the sensitive and vital functions; in Men it does not only perform these, but also all other rational actions, just as if you would suppose a hand of a vast extension, and a prodigious number of fingers, playing upon all the Organ pipes in the world, and making every one sound a particular note according to the disposition and frame of the pipe, so this Universal Soul acting upon all Bodies, makes every one produce various actions, according to the different disposition and frame of their Organs. This opinion he as confidently asserts to be true, as other men believe that it is false; tho' it is impossible he should any other way be sure of it, but by Revelation, and I believe he will find but few that will take it upon his word.

Monsr. Malbranch the famous inquirer after Truth, having made a long and deep search how the Soul comes to have its Ideas, has found out at last, that we perceive not the things themselves, but only their Ideas, which the Soul sees in God. "For says he, the Soul is united to God in a much stricter and more essential manner than she is united to the Body; and this union is by his
"presence,

"presence, so that it may be said, that
 "God is the place of Spirits, as space
 "is the place of Bodies. He tells us
 "also, that since God has the Ideas of
 "all beings in himself, the Soul must
 "needs see what there is in God which
 "represents created beings; for Bo-
 "dies are not visible of themselves,
 "they not being able to act upon our
 "mind, nor represent themselves to it;
 "therefore they being unintelligible in
 "their own Natures, there is no possi-
 "bility of seeing them, except in that
 "being, which contains them after an in-
 "telligible manner*. Bodies therefore
 and their properties are seen in God, so
 that a man who reads this Book does
 not really see the Book it self, but only
 the Idea of it, which is in God. Is not
 a man now much the wiser for this un-
 intelligible jargon? I would fain know
 what the Author meant by his seeing
 every thing in God by its Idea, for I
 must confess that the oftner I read his
 long Illustration on this point, I under-
 stand it the less; and I know as little
 how I have my Ideas, as I did before.
 If he had told me that the Soul saw its

* See the Preface and Page 125. first part, and Page 147.
 part second, Oxford Edition.

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Ideas under the Concave of the Moons Orb, where they say *Plato* placed them, I could have had some sort of confused notion of that manner of seeing, but this manner of seeing Ideas, is far beyond my imagination. I am sure that *I can neither see the Idea of it in God, or any where else;* The truth is, I have not so courageously resisted my senses; as that Philosopher advises, as to be able to penetrate such a solid piece of nonsense.

The same Philosopher affirms that Bodies of their own nature are neither heard, seen, smelt, nor tasted, and when for example we tast any thing, the Body tasted cannot produce any favour in us, but God Almighty takes that occasion to stir up that sensation in us, to which the body does not really concur. Nay according to him it is impossible for any man to move his own Arm, but when he is willing to move it, God takes it and moves it up and down, as the man, whose Arm it is, wills. If a Rebellious Son or Subject murder his Father or his Prince by stabbing him, the Man himself does not thrust the Poiniard into his Fathers or Princes Breast, but God Almighty does it, without any other concurrence of the Man but his will. These
indeed

indeed are strange and unaccountable fancies, But he proceeds still further, and affirms that no second causes act, so that no Body tho moved with never so great a velocity against another can be able to drive that other before it, or move it in the least, but God takes that occasion to put it in motion. At this rate one need not fear his headpiece tho a Bomb were falling upon it with all the force that Powder can give it, for it could not so much as break his Skull, or singe his hair, if God did not take that occasion to do it. The most natural agents with him are not so much as instruments, but only occasions of what is produced by them, so that a man might freely pass thorow the fire, or jump down a precipice without any harm, if God Almighty did not take that occasion to burn him, or dash out his brains. To prove that our moderns are as wild, extravagant, and presumptuous as any of the Ancients either Poets, or Philosophers, I may instance in Dr *Comer*, whose imagination has taken a flight beyond the spheres of sense and reason. Other Philosophers were only ambitious to explicate nature, and the common effects of it, but no less a subject can satisfy him

him, than the Omnipotent Author of nature, and his extraordinary and miraculous acts, which he pretends to explain, for he thinks he understands them as well as he does the common Phenomena of Nature. This I believe will be granted him without much difficulty, for there is very good reason, to believe, that the works of Nature, are as much hid from him, as the mysteries of it, which he treats of, are from others. And tho he talks that he has well considered the Laws of motion, and the force of Nature, yet it is plain that he knows not how to determine what proportion of motion there is in two bodies whose bulks and velocities are given. One can neither be the wiser or better for what he has written, except to be convinced of the reasonableness and excellency of modesty and humility, seeing his attempts are as unsuccessful, as they are shamefully impudent. And yet his Book must have the Sacred name of *Evangelium* prefixt to it, for which the Divines should severely Chastise him, to whom I leave him.

But *M. Des Cartes* the great Master and deliverer of the Philosophers from the tyranny of *Aristotle*, is to be blamed for
all

all this, for he has encouraged so very much this presumptuous pride in the Philosophers, that they think they understand all the works of Nature, & are able to give a good account of them, whereas neither he, nor any of his followers, have given us a right explication of any one thing. So ridiculous are the things he has delivered in his principles of Philosophy, that it is a wonder how they should be believed by any, but it is still a greater wonder how they came to be so much applauded and received among the Learned, as they were. I will here set down some of the strange Schemes and unaccountable fancies of this Philosopher. He assures that there is always the same quantity of motion in the World, so that if all the Men and Animals in the World were moving, which most part of them can do when they please, yet still there would be no more motion in the World than there is in the night time when they are at rest, and what motion they had when they were moving, must be communicated to the *Æther* when they are at rest. Another opinion of his about motion, as strange as the former, is this, if there be two contiguous Bodies A, and B; and if

if B, were carried towards C, by the



very same action A. is transferred from B; so that there is an equal quantity of motion, and action, in both, tho' to all mens senses, the body A seems not to be moved at all. Another law of motion, as contrary to sense as any of the former, is; that if there be two bodies, one of which is bigger, tho' by a very little than the other, the lesser, tho' moved with never so great a velocity against the former, which is at rest, can never put it in motion. Notwithstanding these and many other of his absurd notions, he had a strong party of the Philosophers on his side, and great was the outcry against Aristotle, for his tyrannical usurpation of the liberty and property of the Philosophers to think and say what they had a mind: tho' what they said was much more absurd than Aristotle's *inmixta*, or the Schoolmens substantial formes, which must give way to Mons. Des Cartes's ingenious hypothesis, who, as his followers pretended, could solve

solve all the phenomena in nature, by his principles of matter, and motion, without the help of attraction and occult qualities. He was the first world-maker this Century produced, for he supposes that God at the beginning created only a certain quantity of matter, and motion, and from thence he endeavours to shew, how, by the necessary laws of *Mechanisme*, without any extraordinary concurrence of the Divine Power, the world and all that therein is might have been produced. Nay he was so bold, that he pretended he could solve that insuperable problem, *viz.* having a quantity of matter and motion to produce any animal. But with what confidence could he pretend to solve so intricate a problem, who blundered so much in the easiest and most abstracted things in nature, (for such are the laws of motion) that of the seven rules he has given us about motion, there is but one of them true.

I wonder therefore why Mr. *Wotton* in his reflections on ancient and modern Learning, "should say that *Des Cartes* "joined to his great genius an exquisite skill in Geometry, so that he wrought upon intelligible principles, in
 an

"an intelligible manner, tho' he very
"often failed of one part of his end,
"namely a right explication of the Pha-
"nomena of nature, yet by Marrying
"Geometry and Physicks together, he
"put the World in hopes of a Masculine
"offspring. This I think is a clearer de-
"monstration than any in *Des Cartes's* prin-
ciples of Philosophy, that Mr. *Wotton* either understands no Geometry, or else
that he never read *Des Cartes's* principles, for from the beginning to the end of
them there is not one demonstration
drawn from Geometry, or indeed a-
ny demonstration at all. Except Mr.
Wotton will say, that every thing that is
illustrated by a figure, is a demonstrati-
on, and then indeed he may produce e-
nough of such demonstrations in his
Philosophical works. So far was *Des*
Cartes from Marrying Physicks with
Geometry, that it was his great fault
that he made no use at all of Geome-
try in Philosophy. It may perhaps be
thought that he understood Geometry
as well as most of his contemporaries, and
therefore Mr. *Wotton* might have pre-
sumed, that he ought to have joined
Geometry to natural Philosophy, but
since he asserts that he actually did
so,

*This passage is vindica-
ted by Mr. Wotton in
his Defence of his Reflec-
tions. pag. 3. 4. 5. 6 Ed.
Lond. 1705. in 8^o.*

so, I think it a convincing argument that he makes himself a judge of things he does not understand. But what he falsely ascribes to *Des Cartes*, is really true of *Galileo* and *Kepler*, who, by the help of Geometry have discovered Physical truths that are worth more than all *Des Cartes's* Volumes of Philosophy, who was so far from applying Geometry and observations to natural Philosophy, that his whole System is but one continued blunder upon the account of his negligence in that point. This I can easily prove by shewing that his Theory of the *Vortices*, upon which his Systeme is grounded, is absolutely false. The great Philosopher of this age, the most Ingenious and Incomparable Mr. *Newton* by his great and deep skill in Geometry, has shewed that the periodical times of all Bodies which swim in a *Vortex*, must be directly as the squares of their distances from the center of the Vortex. But it is evident from observations, that the Planets in turning round the Sun, observe quite another sort of a law than this, for the squares of their Periodical times, are always as the cubes of their distances, and therefore since they do not observe that law,
which

which of necessity they must, if they swim in a *Vortex*, it is a demonstration that there are no vortices, in which the Planets are carried round the Sun.

Besides if the earth were carried in a *vortex*, it must necessarily move faster, when it is in the beginning of *Virgo*, where the fluid is in a narrow space, (and by consequence moves so much the swifter,) than it would do when it is in the beginning of *Pisces*, and that in the proportion of three to two, which is directly against experience, and observation.

It is impossible therefore upon this, and a great many other accounts, which Mr. *Newton* has shew'd in his principles, that the earth and the other planets can move in a *Vortex*. So that the notion of a *Vortex* being ruined, the whole *Cartesian* system must of necessity fall to the ground; and that world, whose origination he pretended to have deduced from Mechanical principles, must be a wild chimera of his own imagination.

I cannot pass without reflecting upon another great error in the *Cartesian* Philosophy, which he committed purely for want of due observations. And that is, his reason why at the Moons

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opposi-

opposition, or conjunction with the Sun, the Tides should be greater than at her quadratures. To explain this, he makes the Moon move round the earth, in an Ellipsis, in whose centre the earth is placed, so that by this means, the Moon will have two *Apogeons*, and two *Perigeons*, and he says that the Moon is in one of her *Perigeons* always at the time of her opposition, or conjunction, and by this means she presses then more strongly upon the Sea, than she does at her quadratures, at which time according to him she is alwayes in one of her *Apogeons*, and therefore her pressure must be weaker. All this is so notoriously false, that there is no Almanack-maker but can demonstrate the contrary, and if he had but in the least considered the Theory of the Moon, he might easily have seen that the Moon is as often in her *Apogeons* at new and full Moon, as she is in her *Perigeons* at that time, tho' it seldom happens at the lunations that she is exactly in either.

By this it may sufficiently enough appear, that the most ingenious thoughts in the Cartesian Philosophy, are false, and disagreeable to nature, which I have shew'd not only because the Philosophers

losophers of that sect have pretended to so very great things, as to give a true account of all the Phænomena's in nature, whilst they understand so very little, that they have not given us a right explication of any one thing; but also because Mr. *Des Cartes*, the author of that Sect, was the first who introduced the fancy of making a World, and deducing the origination of the Universe from Mechanical principles. Which notion has been so stiffly maintained by his admirers, that by it they have given the ignorant Atheists (for so are most of that persuasion) some plausible pretences for their incredulity without any real ground.

But of all Philosophers, those have done Religion the least service, who have not only asserted, that the world was made by the laws of Mechanism, without the extraordinary concurrence of the Divine power, but also that all the great changes which have happened to it, such as the Deluge, and other great effects delivered to us as miracles by the sacred writers, were the necessary consequences of natural causes, which they pretend to account for. These contrivers of Deluges, have furnished the A-

theist with an Argument, which upon their supposition is not so easily answer'd as their Theories are made. Which is this.

The World they will say, was never either made or created by God in time, but did exist from all eternity, without any change, or alteration, but such as happened from pure Mechanical principles, and causes, and the true reason, why there remain no records; or traditions of facts done in the time beyond four or five thousand years, is because there has happened a Deluge, the memory of which is still preserved, and this Deluge being the necessary consequence of natural causes, did sweep away all mankind, and with them the memorials of all former ages, only a couple of ignorant country people some way or other, saved themselves from the universal Catastrophe, and from their offspring the earth was again replenished, and arts and sciences invented, which our forefathers before that deluge understood more perfectly than we do now.

This they will tell you is their hypothesis, and they will not be beaten easily from it, since it may be defended

as well, as any other Philosophical Theory which pretends to give an account of the origination of the World, and is as precarious as their own system of principles which they pretend is very possible; since several Philosophers have shew'd various ways, how there might have happened so universal a deluge, from Mechanical principles, and the necessary laws of motion.

Thus we see how these flood-makers have given the Atheists an argument to uphold their cause, which I think can only be truly answer'd by proving an universal Deluge from Mechanical causes altogether impossible. And therefore I design to shew that the most ingenious Theories fram'd upon that account, come far short of the design of the Framers, and that the great and wonderful effects, which they endeavour to explain, could never have risen from the causes they assign.

This I intend to do by shewing that their Theories are neither consonant to the established laws of motion, nor to the acknowledged principles of natural Philosophy; of that Philosophy I mean, which is founded upon observations and calculations, both which are undoubt-

edly the most certain principles, that a Philosopher can build upon. It is in vain to think that a system of Natural Philosophy can be framed without the assistance of both, for without observations we can never know the appearances and force of nature, and without Geometry & Arithmetick we can never discover, whether the causes we assign are proportional to the effects we pretend to explain. This the various systems of the Philosophers do evidently shew, which are by far more distant from the truth, than they are from one another. And I hope it will appear yet plainer by the following examination of *Dr. Burnet's Theory of the Earth*. Which tho it has been published many years, and has been animadverted upon by several, yet it has not been so fully refuted as it might have been, nor has any one shew'd the greatest mistakes in it. Nay, Mr. *Erasmus Warren*, who has wrote the greatest Volume against it, in my opinion has spoken the least sense about it.

He begins his discourse with a saying of an old Heathen, that Philosophy is the greatest gift that ever God bestowed on man, Which I will not deny, since he has been at so much pains to make a

Panegy-

Panegyrick on the usefulness of it. But it is plain to any who will be at the pains to read his Book, that God has thought fit to bestow but very little of that great gift upon him. And that the world may not think that this is said out of ill nature and without grounds, I will give them a taste of his Philosophy, Geometry, or Geography, (call it which you please.) He designs to calculate how much colder the *Poles* would be if the earth were of an Oval figure, than if it were perfectly Spherical. To do which he supposes that a Circle formed into a moderate Oval, will have its *Poles* at least a fortieth part farther distant from the *equator*, than if it were perfectly spherical. * "Now according to this proportion, allowing the earth to be 7000. miles in Diameter and adding a fourth part to render it Oval, viz. 1750 miles thickness; the earth at each Pole must bear above fourteen degrees latitude more than if it had been round. So that the hypothesis which removes its Poles so much farther from the Sun, must also allow the cold thereabouts to be proportionably augmented. And though in the hundred and fourth

* *Warrin's Geology* page 116.

“degree of latitude (as we must call it)
 “on each side of the *aquator*, that is, at
 “the very Poles, there might have been
 “a perpetual day, &c.

This is the first time I ever heard that there could be more than ninety degrees between the pole and the *aquator*, but he thinks he has fairly made it out that there can be a hundred and four degrees between them, & therefore, there must be four hundred & sixteen degrees in the whole circumference, and then, every right angle being only proportional to ninety degrees, there must be more than four right angles about one point, and therefore the Corollary of the 13th of the first of *Euclid* must be false. Thus has that subtle Philosopher not only subverted Dr. *Barnet's Theory*, but also *Euclid's* demonstrations, and that by an argument which the dull Mathematicians could never discover.

But I will leave *Euclid* to his mercy, and answer that part of his argument that concerns the *Theory*; which is easily done, if he will consider that the difference between the *poles* of the earths distance from the Sun; and the *aquator* of the earths distance from the Sun,
 even

even tho the earth were ten times more Oval than he would have it, is so very inconsiderable that it does almost bear the same proportion to the whole that a point does to a line, for the Mathematicians know that the diameter of the earth is but a point, in respect of its distance from the Sun, and therefore two lines drawn from the Suns centre to any two points of it are very near in a proportion of equality, so that upon the account of a greater or lesser distance of the parts of the earth from the Sun, there can be no sensible alteration of heat or cold.

But I am afraid this is a little too far beyond Mr. *Warren's* capacity, however to surprize him a little more, I will tell him, he is so far out in his account of the cold at the *poles*, that tho the North *pole* be much colder in the Winter than it is in the Summer, yet is it some hundred thousands of miles nearer to the Sun in Winter than in Summer. If he pleases to consult the Astronomers, they can demonstrate the truth of this to him.

I beg Mr. *Warren's* pardon for bringing him into this place, I ought to have been favourable to him, he being one of
my

my Associates against Dr. Burnet. But I was willing to produce him as an instance, to shew how unfit a man who understands no *Geometry*, is to write a book of *Natural Philosophy*.

But to return to the *Theory*, I cannot but acknowledge, that there was never any book of *Philosophy* written with a more lofty and plausible stile than it is, the noble and elegant descriptions the Author gives the subject he treats of shew that he has a great command of Language. His Rhetorical expressions may easily captivate any incautious reader, and make him swallow down for truth, what I am apt to think the Author himself, from the sacred character he bears, designed only for a *Philosophical Romance*, seeing that an ordinary examination thereof, according to the laws of *Mechanisme* cannot but shew, that he has acted the part of an *Orator* much better than he has done that of a *Philosopher*. For in reality none of these wonderful effects, which he indeavours to explain, could have proceeded from the causes he assigns. And to demonstrate this is the design of this small *Treatise*, in which I will not inquire how far the *Theory* is agreea-

agreeable to Holy Scriptures, that being a work already done by others, who I presume understand that Subject better than I do, neither will I confine my self to follow the Author from Chapter to Chapter, and find fault with every thing contain'd in the Theory, least it should look more like spitefulness and ill nature than a diligent search after Truth. My design therefore is to choose out some of the principal heads of the Theory, and having shown them to be false and disagreeable to the laws of Mechanisme, the rest must all fall to the ground of course.

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CHAP. I.

An Examination of the Theorist's general Argument which he uses to prove the Truth of his Theory.

IN the second and third Chapters the Theorist makes way for an Argument which he alledges in his seventh to prove the truth of his Theory, viz. that all other ways for the explication of *Noah's Flood* are false and impossible, and that he has given the only possible, and consistent Idea of an universal flood, and therefore it came to pass the way he has assigned and no other. This Argument we see is founded upon two Propositions. 1st. That no other way is possible, and 2^{dly} That his own Theory is an intelligible and consistent explication of the universal flood. This last Proposition I intend to examin in the following Chapter, and the first in this.

The Theorist, to prove all the common ways of explicating the universal deluge false and impossible, Calculates the

the quantity of water, which would be sufficient to cover the whole earth, above the tops of the highest Mountains, and finds that no less than eight Oceans of water could be sufficient for such a work. Now it is certain (says he) that such a stock of waters could neither come from the Sea, the Rain, or subterraneous Caverns, & Channels of the earth, there being no such quantity of water in nature, as would be requisite for such a purpose: and therefore the explication of the deluge from these causes is impossible. Neither will he allow any supercelestial waters to make up the eight Oceans necessary for the deluge. For if there were any such waters, the Heavens above where they lay must be either solid or fluid. If solid as Glass or Chrystal, how could the waters get thro them to descend upon the earth? If fluid as the Air or *Aether*, how could the waters rest upon them it being heavier than Air? But if you will suppose, that waters were brought down from this imaginary region, to drown the world, in that vast quantity that would be necessary, what became of them when the deluge ceased? It would be a hard task to lift seven or eight O-

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ceans

ceans of water up among the spheres, and there is no room for them here below. Thus the Theorist thinks, that the vulgar ^{opinion} makes the deluge impossible and unintelligible upon a double account, both in requiring more water than can be found, and more, if found, than can be dispos'd of.

This is the sum of the Theorist's Argument, why all other methods and explications of the deluge are false, and impossible, which I have here related, because I think it an evident demonstration of the impossibility of all *Natural* and *Mechanical* explications of the deluge whatsoever, even his own not excepted, as I shall shew in its due place: it being impossible for Nature, not assisted with extraordinary divine power, to bring so much water upon the earth; and if it were once brought, it is as impossible to ^{re}move it.

But all this does no way prove, that the deluge might not have been brought upon the earth by the Almighty power of God. Cannot he bring out the waters from the deep, or the *Abyss* as from a Storehouse, and sustain them from running down again with the same ease he made the waters of the red Sea stand on

on an heap, while the *Israelites* passed through? Is any thing of this nature too hard for the Almighty to perform? Might not he, if there were not enough in the abyſſe, bring water on the earth from the Heavens above, which might have been there from the Creation notwithstanding the Theorist's question, How could they rest there? Since the same power might keep them in their place, that detains the Moon or any other of the Planets in their orbits; and perhaps from some of these, or from other places best known to the Divine wisdom, some of this water was brought upon the earth, and afterwards remov'd by the Omnipotent hand of God who only worketh great wonders. Is not this a much easier and shorter account of the deluge than the Theorist's, which is built upon false and precarious principles, inconsequential conclusions, which after all will not be sufficient to produce the desired effect?

But it seems the Theorist is not very willing to acknowledge that God Almighty had any hand in that great Catastrophe of the world, tho' it be plainly told us in Scripture that he was the immediate Author thereof, *Gen. 6. 17.*

Behold,

Behold, (saith God) I even I, do bring a flood of waters upon the Earth. Nor do I see any reason why he ought not to acknowledg the universal deluge of the world to be Miraculous, as well as the destruction of *Sodom* and *Gomorrhah* was by raining of Fire and Brimstone; since they were both sent as punishments for the sins of men: neither of which, without doubt, had ever happened if man had continued in the state of Innocence.

The Scriptures give us an account of several Miracles wrought by the hand of Omnipotence upon occasions, which did not so necessarily require them. Why ought we then to deny this universal destruction of the earth to be miraculous? Miracles are the great & wonderful works of God, by which he sheweth his Dominion and Power, and that his Kingdom reacheth over all, even Nature herself, and that he does not confine himself to the ordinary methods of acting, but can alter them according to his pleasure. Were not they given us to convince us of the sacred truths contained in holy Scripture? Was it not by the demonstrative force of Miracles that *Moses* and the Apostles proved their divine Mission, beyond all that other Framers of Religions

Religions could pretend to? And tho' our holy Faith stands so well confirmed by real miracles, that we are neither to make nor admit of any false ones, yet certainly we are not to detract from the value of the true ones, by pretending to deduce them from *Natural* and *Mechanical* causes, when they are no ways explicable by them. It is therefore both the easiest and safest way, to refer the wonderful destruction of the old world to the Omnipotent hand of God, who can do whatsoever he pleases.

C H A P. II.

Of the Chaos.

THat the Earth was formed from a *Chaos*, must be unquestionably own'd by all, who acknowledge the truth of the Holy Scriptures, for they tell us, that in the beginning *the Earth was without form and void, and darkness was upon the face of the deep*: which is a most excellent description of that *Chaos*, from which the world arose. From it therefore the Theorist begins to frame his Antediluvian earth by the sole help of Natural and Mechanical causes. He supposes the *Chaos* to be the matter of the earth and heavens, without form or regularity, reduc'd into a fluid Masse, wherein are the materials and ingredients of all Bodies mingled in confusion one with another, without any order of higher or lower, heavier or lighter, solid or volatile. The first change he imagins that did happen to this Masse, was, that the heaviest and grossest parts sunk down towards the middle of it (for there he supposes the Center of its gravity)

gravity) and constituted the hard and solid interior part of the earth. The rest of the Masse which swam above, was also divided by the same principle of gravity into two orders of bodies, the one liquid like water, the other volatile like air. For the fine and active parts disintangling themselves by degrees from the rest, did mount above them, and having motion enough to keep themselves upon the wing, did play in these open places, where they were to constitute that body we call Air: the other parts being grosser than these settled in a masse together under the air, upon the body of the earth, composing not only water strictly so called, but the whole Masse of liquors or liquid bodies belonging to the earth; of which there were two kinds, one of which is fat, oily and light, and the other lean and more earthy, like common water. Now it being well known that these two liquors mixed together, if left to themselves and the general action of nature, separate one from another, as in Cream and thin Milk, oil and water, and such like. So we cannot doubt but that the same effect would follow here, and the more oily and light parts of this Masse

would get above the other and swim upon it. Thus would the whole Masse of liquids be divided into two lesser Masses.

Now if we look over again these two great Masses of Air and Water, we cannot but imagin, that they were both at first very muddy and impure: for the air was yet thick, grosse and dark, there being abundance of terrestrial particles swimming in it still, after the grossest were sunk down, and the lesser and lighter, which remain'd in the Air, did sink too, but more slowly. So that in their descent they did meet with the oily liquor upon the face of the deep, which did intangle and stop them from passing any further, so as mixing there with that unctuous substance, they did compose a certain slime, or fat, soft earth, spread upon the face of the waters. And this thin and tender Orb increased more and more as the little earthy particles detain'd in the air could make their way to it; and mingled with that oily liquor, till at length they sucked it all up, and were wholly incorporated together: which was the first concretion and firm consistent substance upon the face of the Chaos.

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After this fashion has the Theorist formed his Antediluvian habitable world, which doth not much differ from the *Cartesian* method of making the earth: only *Des Cartes* being somewhat wiser than the Theorist, would not allow the outward crust, within whose bowels the waters were shut up, to be a habitable earth, knowing well that neither man nor beast could live long without water. But he made the crust first broken, and the waters flow out, before he plac'd any inhabitants on it. Another small difference betwixt the two hypotheses, is, that *Mons. Des Cartes* never thought of making the exterior Orb of oily liquids, which the Theorist asserts to be absolutely necessary towards the formation of the crust. For if it were not, says he, for the oily liquor which swims upon the surface of the Abyss, the particles of earth which fell through the air had sunk to the bottom, and had never formed the exterior Orb of earth.

But notwithstanding this, I believe it may be easily made evident (tho' neither of their Systems are true) that the Theorist's hypothesis is the worst of the two. Which I will prove from his own concessions: for he has already own'd

that the oily liquor is much lighter than the watery Orb. He has mentioned also that the terrestrial particles when falling from the air, if the Orb were only water, would sink to the bottom, and therefore those particles must be heavier than water. From thence, I think, it does necessarily follow, that these terrestrial particles must also be heavier than the oily fluid which is lighter than water, and therefore they will more easily descend thro' it than they did thro' water, it being well known that there are several bodies which will swim in water, but sink in oil.

But that which seems to have deceiv'd the Theorist in this point was, that he had observed that small dust, tho' specifically heavier than oil, yet being thrown upon it, it did not sink, and therefore he concluded, that a great deal of it, if cast upon the surface of oil after the same manner, would not descend, but form a solid concrete substance upon the surface of the oil. But this consequence will soon appear to be false, if we consider the true reason why some bodies, tho' specifically heavier than the fluid in which they are put, do not

not sink, but swim upon the surface: which is this. That there is scarce any liquid in nature which is absolutely fluid, and whose parts do not resist separation one from another, and therefore will somewhat hinder or retard the descent of bodies thro' them. Now this resistance (all other things being alike) is always proportional to the surface of the body descending: so that small bodies, whose weight or force to move or separate the parts of the fluid, is but very little, may have a surface so large, that they cannot overcome the resistance of the fluid: that is, they cannot make way for their descent thro' the fluid, and therefore must swim upon the surface of it: but the surfaces of bodies not increasing in the same proportion with their solidities or weights, small bodies (will have a greater resistance in proportion to their weight, than greater ones of the same intensive gravity, and consequently the one will descend when the other cannot. As for example, suppose a sphere of an inch diameter, was put into an oily fluid, whose resistance was just equal to the force of gravity in the descending body: there being an equilibrium, the former would swim in the

latter. Now if another sphere of two inches diameter and of the same intensive gravity were put in the same fluid, its gravity or force by which it would separate the particles of the fluid, would be eight times greater than the descending force of the former sphere; and if its resistance were also eight times greater, it is plain that it also could not descend: but the resistance being always, (as I noted before) as the surface of the descending body, is only in the present case four times greater, which will not equal the force of its gravity, and therefore the sphere must descend. So in our present case, tho' some small grains of dust or earth may swim upon the surface of Oil, yet these when increased by the addition of a great many others which fall upon them, augment their weight (the same resistance continuing) and must fall to the bottom.

Besides this, the earthy particles falling from a great height, some of them descending from places as high as the Moon, as the Theorist will have them, must needs in their descent acquire a very considerable degree of velocity, with which falling upon the surface of the oily Orb, they will not only by that force

force descend themselves, but also carry down with them, and condense whatsoever bodies they meet in their way, or found swimming upon the surface of the oil. Now that the force of a descending body is so great as to perform this effect, I think is clear to any who considers that a heavy body runs down fifteen foot in a second, and that the spaces thro which it does move, are always in duplicate proportion to its times, as is demonstrated by Galileo and confirmed by the experiments of Riccioli: from whence by calculation it will follow that a body would run down four thousand miles in the space of twenty three seconds, abstracting from the resistance of the air. But if we will suppose but the hundredth part of this space run thro in that time, allowing all the rest for the resistance of the Medium, yet even in this case, the velocity would far exceed that of the swiftest bullet that can be shot out of a Cannon. Thus, I think, I have made it evident, that the particles of earth, after falling thro the air, could not rest upon the surface of the oily Orb, to form there an hardened habitable Crust, not only upon

upon the account of their greater gravity, which the Theorist acknowledges, and is also plain by experience; common earth being near twice as heavy as water; but also upon the account of the great force by which they must of necessity fall upon the liquid Orb, which will carry them down towards the Center.

I hope now it will appear to any thinking man, plainly impossible, that either oil or water should sustain such an immense heavy Orb, in which was not only the soft earth, which in few places is ten foot deep, but also a prodigious quantity of stones and minerals much heavier than water: for it is certain that these great heavy bodies must have sunk to the bottom if they were left to themselves, and yet these bodies make up the greatest part of our outward earth. I know the Theorist does boldly affirm, that there was neither Metals nor Minerals in the primitive earth, but this is both contrary to reason and Scripture, for the Holy Scriptures tell us, that *Tubal Cain* before the flood, was an instructor of every Artificer in Brass and Iron: and I would fain know, how there could be such Artificers before the

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flood when according to him there was no such thing to be seen as Metals. Besides, 'tis hardly possible to build an Ark, that should contain all the terrestrial and aerial animals, without Iron. The *Americans* without any Iron made themselves small Cannoes of one solid piece of Timber which they hollowed by burning; but it would be a strange Tree that was of the dimensions of the Ark, and could contain so many animals as it did. These things do (in my judgement) plainly show, that the Theorists opinion in this point is utterly false.

From what I have already said, I think, it may be clearly demonstrated, that the Fabrick of the earth can never be deduced from a Chaos, by the sole help of Mechanical principles and Natural causes. For it is evident to any one who has eyes (tho' there have been some wise Philosophers of another opinion) that the Land is higher than the Water; and it is also plainly experienced, that common arable earth or clay is much heavier than water: and if we descend into the Mines or Pits, we shall find the matter there to be three or four times heavier than the earth above. Now it is plain from what I have

have already proved, that in a Chaos, the true change that would follow from Mechanical principles and Natural causes, is, that if all were fluid, the heaviest & solidest Bodies would subside and fall to the Center, every one taking place according to the specifick gravity; so that the lighter Bodies would always be forced uppermost: the earth therefore being heavier than the water, must of necessity place it self nigher the Center, and leave the water to cover the face of the whole Orb. Thus the surface of the World could never be inhabited by any other Animal than Fishes. But in how much wiser order than this, has the great Creator of the World plac'd all the Bodies of the earth, so that notwithstanding the greater gravity of the Land, it is rais'd higher than the Sea, and thereby made fit and habitable both for man and beasts, without the help of Natural and Mechanical causes, which would have produc'd the contrary effect.

Several other arguments might be brought to demonstrate that the frame of this World was the result of wisdom and counsel, and not of the necessary and essential Laws of motion
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Of the Theory.

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gravitation, which could never have either made or supported the World. I always wonder'd at the wild and extravagant fancy of the Philosophers, who thought that brute and stupid matter would by it self, without some supreme and intelligent director, fall into a regular and beautiful structure, whose parts should be so extreamly well adapted to various uses, as if they had been the result of wisdom and contrivance. I will conclude this Chapter with a discourse of the Theorist in his 10th Chap. lib. 2.

“ In the construction of the Body of
“ an Animal, (says he) there is more of
“ thought and contrivance, more of ex-
“ quisite invention, and fit dispositions
“ of parts, than is in all the Temples,
“ Palaces, Ships, Theaters, or any other
“ pieces of Architecture the World ever
“ yet saw, and not Architecture only,
“ but all other Mechanism whatsoever,
“ Engines, Clock-work, or any other is
“ not comparable to the Body of a liv-
“ ing creature. Seeing then we acknow-
“ ledge these artificial works, whereso-
“ ever we meet with them, to be the
“ effects of wit, understanding and rea-
“ son; is it not manifest partiality or
“ stupidity

“stupidity rather, to deny the works of
 “nature, which excell these in all de-
 “grees, to proceed from an intelligent
 “principle? Let them take any piece
 “of human art, or any Machine fram’d
 “by the wit of man, and compare it
 “with the Body of an Animal, either
 “for diversity and multiplicity of work-
 “manship, or curiosity in the Minute
 “parts, or just connexion and depen-
 “dence of one thing upon another, or
 “fit subserviency to the ends propos’d
 “of Life, Motion, Use, and Ornament
 “to the creature: and if in all these
 “respects, they find it superior to any
 “work of human production, as they
 “certainly must, why should it be
 “thought to proceed from inferior
 “and senseless causes? ought we not
 “in this as well as in other respects to
 “proportion the causes to the effect,
 “and to speak truth, and bring an ho-
 “nest verdict for Nature as well as for
 “Art?

I desire the Theorist may apply this
 excellent discourse to himself, and con-
 sider whether this Argument which he
 produces against the Epicureans and
 Atheists, does not fully show the absur-
 dity of his own Theory.

Of the Mountains.

THE Theorist frames his *Antediluvian* Earth, smooth, regular and uniform, without Mountains and without a Sea. The proof which he brings for this bold assertion, is, that the Globe of the Earth could not rise immediately from a Chaos into the irregular form, in which it is at present; the Chaos, says he, being a fluid Masse, which we know does necessarily fall into a spherical surface, whose parts are *equidistant* from the Centre, in an equal and even convexity one with another. And since upon the distinction of the Chaos, and separation into several elementary Masses, the Water would naturally have a superior place to the Earth, 'tis manifest there could be no habitable Earth form'd out of the Chaos unless by some concretion upon the face of the Water. Then lastly seeing this concrete Orb of Earth upon the face of the Water would be of the same form with the surface of the Wa-

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ter it was spread upon, there being no causes that we know of, to make an inequality in it, we must conclude it equal and uniform, and without Mountains, as also without a Sea. For the Sea and all the Masse of Water was inclos'd within this exterior Earth, which had no other basis or foundation to rest upon.

This is the Theorist's great argument why the face of the primitive earth was smooth and uniform and without Mountains; which if we consider narrowly, it will appear to depend upon a precarious and false supposition, namely that the great Masse of matter which we have now for our earth, was, when in a Chaos, an entirely fluid Masse, which is a hard thing to be granted, since the greatest parts of Bodys we have in the earth, at least so far as we can discern, are hard and solid, and there is not such a quantity of water in the earth, as would be requisite to soften and liquify them all. Besides, a great part of them, as Stones and Metals, are incapable of being liquified by water. We must conclude therefore that the Chaos was not so fluid a Masse, as would be necessary for to have it's surface

surface even and uniform. Why might not there have been in this great Masse huge lumps of firm and solid matter, which without any form, order, or regularity, might be jumbled together, and swimming up and down, some on the surface, and some within the fluid? I will leave it to any to judge which appears most like a Chaos, this which I have describ'd, or his, which is a regular, uniform fluid of a spherical figure, so compos'd and mix'd with all Bodies, that no part of it, at least at the same distance from the Centre, is thicker than another: which must necessarily fall out, if the Chaos had an exact spherical figure, as the Theorist supposes. If it were otherwise, it is plain by *Hydrostatical* Principles, that there the fluid would rise highest, where it is thinnest, or lightest; and consequently it would not have its surface uniform, equally even and distant from the Centre.

Indeed, methinks the Theorist's first figure of the Chaos, does very much contradict his own hypothesis. There you may see represented great pieces of hard and solid matter of no regular figure, swimming confusedly in the fluid; any one of which seems to bear a far

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greater proportion, to the whole Masse than the highest hills could do to the whole Earth.

But perhaps it may be said that all these hard and solid Bodies being heavier than the fluid in which they swam, fell down and compos'd the Central solid. And so far I must own indeed, that all the Bodies in that great Masse, which were heavier than water, if left to the laws of gravity, would necessarily fall down toward the Centre. But certain it is that in such a great heap of matter, and so different mixtures of all sorts,

Mollia cum duris, sine pondere habentia pondus.

there must be several that were specifically lighter than the water in which they swam, and therefore after that the heaviest had fallen to the Centre, they would still float upon the surface, so much of them being under water as would equal in quantity a bulk of water of the same gravity with the whole Masse, as it is demonstrated by *Archimedes 5. Proposition. Lib. 1. De Indivisibilibus Fluminibus*: so that all the rest of the Masse standing out or being higher than the fluid would compose a Mountain. And that hills may be thus made,

made, I think is confirmed by the observation of those who have failed in the *Northern Seas*, where they see great Mountains of Ice floating upon the top of the waters, and yet there is but a very small difference between the specific gravity of water and Ice, it being as eight to seven according to Mr. *Boyle's* observations. If then we will suppose all Mountains hollow and full of Caverns, there being a great many to our certain knowledge that are so, or else joined to some light matter, so that the whole composition may be lighter than water or the fluid Chaos; this would necessarily produce Mountains.

And now I hope the Theorist will own that the evenness and uniformity of the earth is not so necessary a consequence from its production out of a Chaos, as he at first imagined: since I have shewed him how mountains might have been form'd from his own principles of *Staticks* and *Gravitation*. Yet I am of the opinion that there were other principles concurring to the formation of the world, besides *gravitation* and the known laws of motion, which I think if left to themselves would need

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ver produce any tolerable or habitable world.

But supposing the efficient cause of Mountains unknown or impossible to be assigned; yet still there remains the final cause to be inquired into, which will do as well for our purpose. For if I prove them to be as useful to the inhabitants of the primitive earth, as they are now to us, and that in our present state they are absolutely necessary, not only for our well being, but also for our bare subsistence; I think from thence it will demonstratively follow that they were in the primitive earth as well as in ours. And therefore the groundless assertion of the Theorist that the face of the *Antediluvian* earth was smooth regular and uniform, is as false as 'tis bold and daring.

I know there is a sort of men in this age who have excluded all final causes from the consideration of a Philosopher, as being unworthy of his enquiry, supposing his business is only to find out the true formal and efficient causes of all things, and not to concern himself with the design of nature, or the great end for which the God of Nature made any thing. But indeed these men have been

been so unhappy in their searches, that I dare boldly say they have not so much as discovered the true real and efficient cause of any one of the Phænomena which was not known and better explain'd before; tho' they have pretended to lay open the *essences* and *formal causes* of all things; and to shew the manner, how the Universe was formed from the principles of Matter and Motion.

But whatever they pretend, certain it is, that final causes are worthy of the consideration of all men, and much more of a Philosopher. By them we are led into the admiration of the wisdom of God, and discover his care and providence over the world; By them we demonstrate that the World could never be made by chance; but it must be a being of Infinite wisdom that form'd it for such various uses as are to be seen in it. And therefore by all wise and considering men they are much more to be valued than efficient causes, if they could be discovered; which only tell us how the thing was perform'd, and not the use for which it was design'd. 'Tis true indeed, it is not easy to discover the use of every thing in the Universe; but from the admi-

able contrivance of those things, the uses of which we do know, and from the infinite wisdom of God, it may be easily concluded, that every thing in nature has its use, and is in some manner serviceable to the good of the whole.

They who desire to see more concerning the usefulness of final causes, may consult Mr. *Boyle* of final causes, Mr. *Ray*'s wisdom of God in the works of the Creation, and some late ingenious essays upon the nature and evidence of faith by Dr. *Cockburn*.

I must confess I cannot but think it a strange and presuming boldness in the Theorist to assert, that Mountains are plac'd in no order one with another, that can either respect use or beauty: and that if they are singly consider'd, they do not consist of any proportion of parts, that is referable to any design, or hath the least footsteps of art or counsel. Notwithstanding this strange assertion, I am sure, if we were without these shapeless and ill figur'd old Rocks and Mountains, as he calls them, we should soon find the want of them. It being impossible to subsist or live without them.

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For setting aside the use they may have in the production of various Plants and Metals, which are usefull to mankind, and make a part of the compleat whole, and the Food which they yield to several Animals, which are design'd by Nature to live upon them; *The high Hills being a refuge for the wild Goats, and the Rocks for the Conies*; and not to mention the end they serve for in directing the Inland winds, and altering the weather, in fencing and bounding Empires and Countries, in all which without doubt they do us very considerable service; there is moreover one great and Universal use, which makes them absolutely necessary for the subsistence of Mankind. For without them it is certain we should have no Rivers, nor fresh currents of waters, and consequently we should want one of the greatest supports of Life. This the Learned and Ingenious Mathematician and Philosopher Mr. *Edmund Halley* has effectually proved in the *Philosophical Transactions*, where he gives us an account of the rise of Springs and Rivers from Vapours. "That are raised copiously in the Sea, and by

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"the winds are carried over the low
 "Land to the high ridges of Mountains,
 "where they are compelled by the
 "stream of the air to mount up with
 "it to the tops of the Mountains, where
 "they presently precipitate, gleeing
 "down by the crannies of the stones, and
 "part of the Vapour entring into the
 "Caverns of those Hills, the waters
 "thereof gather as in an Alembick, in-
 "to the basons of stone it finds; which
 "being once filled, all the overplus of
 "water that comes thither, runs over
 "by the lowest place and breaking out
 "by the sides of the Hills, forms single
 "Springs, many of these running down
 "by the *valleys* or *guts* between the
 "ridges of the hills, and coming to
 "unite, form little rivulets or brooks,
 "many of these again meeting in one
 "common valley and gaining the plain
 "ground being grown less rapid be-
 "come a River, and many of these
 "being united in one common chan-
 "nel make such streames as the *Rhine*,
 "the *Rhone*, and the *Danube*, which last
 "one would hardly think the collection
 "of waters condensed out of vapours,
 "unless we consider how vast a tract of
 "ground that River drains, and that it
 "is

"is the fumm of all those springs which
"break out upon the South side of the
"Carpathian Mountains, & on the North
"side of the immense ridge of the
"Alpes, which is one continued chain
"of Mountains from Switzerland to the
"black Sea, so that it may almost pass
"for a rule, that the magnitude of a
"River or the quantity of water, which
"it evacuates, is proportional to the
"length and height of the ridges from
"whence its fountain arises.

All this I take to be undeniably evident. For that vapours are raised by the heat of the Sun from the Sea in such vast quantities as will be sufficient to serve all the Rivers, the same ingenious Mr. Halley has demonstrated by Calculations. But it is also demonstrable that these vapours being of the same specifick gravity with the air in which they swim, must follow its motion, that is, they must be carried by the winds over land untill they meet with such an obstacle as a hill in their way which resists their motion, where they must precipitate and gleet down by its side and so form Rivers and Springs. All this is not only clear from reason, but is also confirmed by the experience

perience of the same Mr. Halley while he was at St. Helena as he tells you, in the *Philosophical Transactions*.

And now methinks 'tis plain that hills are so very far from being placed in the earth without any art or contrivance, that they demonstrate to us the admirable wildome of their great maker, who has thus formed them for so necessary ends. If the earth were smooth, regular and uniform; water without doubt would stagnate and stink, for how is it possible for water to run where there is no rising ground, *no upper land* from which it is to descend to the lower and *even parts* of the earth.

I know the Theorist thinks, that he has clearly solved that great difficulty by the oval figure of his *Antediluvian* earth, in which he fancies that Rivers will run notwithstanding the earths regular and even surface. But when I come to discuss that point I will shew that the earth has not, nor ever had any such oval figure as he supposes, and upon supposition in had, yet even in that case there could be no current Water or Rivers; and where there is no current waters there must be but uncomfortable living. How many great parts

parts of the world be perfectly destitute of inhabitants for want of waters? Travellers tell us fearful stories of the incredible *extremities* they have suffered in going thorough the Deserts of *Africa* for want of fresh waters.

It is plain therefore, that if the primitive earth was inhabitable there must be Mountains in it, for I think I have already proved that in a smooth regular earth there could be no Rivers. And the great advantages, which Countries reap by being well furnished with Rivers, is very evident; for without them there could be no great Towns, nor any converse with far inland Countries; since without them it is almost impossible to supply a vast multitude of People with things necessary for life. If we should suppose the *Thames* taken away from *London*, or it's course diverted so as to be at a great distance from it; there is no doubt but that City would quickly to its *loss*, very much find the want of so great an advantage; and from being one of the greatest in the space of some few hundred years, it would come to be one of the least Cities of the Universe.

It cannot be said, though Rivers are

are now in the present state of the world of great use and benefit to mankind, that in the *antediluvian* earth there was no such necessity for them, there being no such great traffick as now, nor such a number of people to be maintained by it. For this seeming objection is clearly solved by the Theorist himself in his third Chapter Book I. where he proves the number of the *antediluvian* people to have been at least as great as they are now, and the world altogether as well peopled. And if so, since men lived then to a very great age, (some of them to nine hundred years) they would be well taught by experience, and understand most of those things which are useful and profitable for them, as well as we do now. But I need not go about to prove there were *Antediluvian* Rivers, since it is plainly asserted by *Moses* that there were such in the second Chapter of *Genesis*, whose authority I hope the Theorist will not deny. For he himself acknowledges their existence before the Flood, and endeavours to explain their rise without the help of mountains; which *explication* in its due place I will prove to be false and impossible.

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Since therefore it is plain from Reason, from Scripture, and the Theorist's own concessions, that there were Rivers in the primitive Earth, and seeing it is impossible for any such to be without Mountains, without higher and lower grounds (the Theorist's *Oval-figured* earth not being sufficient for such an effect) From thence it does ~~not~~ evidently follow, that Mountains were before the flood. And therefore his assertion that the primitive earth was smooth, regular and uniforme, is false and absurd.

CHAP.

CHAP. IV.

*Of the Perpendicular position
of the Axis of the Earth to
the plane of the Ecliptick.*

AMong other Characters of the Golden Age with which the Theorist endows his primitive Earth, one is a perpetual Spring which was then all the world over, all the parts of the years being of one and the same tenour, face, and temper. Then, says he, there was no Winter nor Summer, Seed time or Harvest, but a continual temperature of the Air and Verdure of the Earth. The reason which he brings for this assertion is, that at first the *Axis* of the Earth was parallel to the *Axis* of the *Ecliptick*, and consequently the plane of the *Aequator* being coincident with the plane of the *Ecliptick*, the Sun in its diurnal motion would seem to move always in the *Aequator*, making equal Dayes and Nights throughout the year.

Notwithstanding this fine description of the Theorist's, I hope to make it appear

appear in this Chapter, that the right position of the Earth (as he calls it) is so very far from being desirable as he imagines it is, that it is one of the worst it could have, and that therefore the Earth was never placed by God Almighty at the beginning of the world in such a position. For I here lay it down as an *axiom* which I am confident the Theorist will allow, that God at the beginning placed the Earth in such a position as was most advantageous to the whole, and tho perhaps another position might have been fitter for some particular place, yet the whole would have been the worse for it: God by his infinite wisdom and goodness always choosing such constitutions and positions of things as bring with them the greatest good and utility to the Universe.

Let us therefore consider whither this right position, which the Theorist says was that of the primitive Earth was the best it could have, and if after examination we find that no such Character as that of best belonged to it, but rather the contrary, it being by far more disadvantageous to the Earth than the present one, we may confidently conclude

conclude from the above mentioned axiom that the Earth never had any such position.

ii. That great and learned Astronomer *Kepler*, who certainly had more than an ordinary penetration (nay perhaps a divine impulse) in discovering the works of Nature and Providence, in his *Epitome Astronomiae Copernicanae*, has shewed that the present position of the earths *Axis* is by far preferable to any other, especially to that of the perpendicular position to the plane of the *Ecliptick*, for he tells us in his *Lib. 3. Part 4.* That if the *Axis* of the earth about which it turned stood at right angles, with the plane of the *Ecliptick*, and the earth in the mean time turned round the Sun as it does now, that then indeed the Sun would seem to rise and set every day, and make its circuit from *West* to *East*, under the fixed stars in the space of a year, but then there would be no division of the *Ecliptick* into halves, quarters, and signs, no distinction of the year by its different qualities of heat and cold, every night would be equal to every day, there would be two places in the Earth to whose inhabitants more than half the Sun could never

never appear but its Centre would continually turn round in their *Horizons*, never rising higher nor falling lower, the nearer one came to the *aquator*, so much higher would he have the Sun in his *meridian*, but in the same place it would alwayes be at a constant height at twelve of the Clock. In the *aquator*, the Sun throughout the whole year would alwayes be *vertical* when it comes to the *meridian*, and there only, would there be an intense and perpetual Summer, when at the *poles*, and in places near them, there would be an eternal Winter without any intermission of Frost and Snow. The Sun also would alwayes Rise and Set in the same points of their *Horizons*, and therefore, there would be no alteration in the Earth, but upon the account of day and night, and no sort of changes in the year which would alwayes keep the same tenour and face, the annual motion of the earth being of no use.

These are the effects which the Learned *Kepler* has shewed, would necessarily follow from the position of the Earths *axis*, which besides, that it makes the Earths Annual circuit round the Sun of no sort of use and advantage to

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it, (And this I suppose cannot well agree with the infinite wisdom of its Maker,) it brings with it such a train of consequences, which if men would consider, I believe there would be few so fond of changes, as to be willing to have the present oblique position altered for the perpendicular one of the Theorist, which would render this whole Island no better than a wilderness, and the greatest part of the Earth not habitable.

For under the *Æquinoctial*, to whose inhabitants, the Sun would continually at twelve of the Clock, shine perpendicularly and even throughout the *Torrid Zone* there would be an intolerable scorching heat; In the *Frigid Zone* the cold could not be indured, and the greatest part of the two temperate *Zones* would not have a sufficient quantity of heat to ripen their fruits. All men in *England* are sensible that the heat we have in Summer, is but just great enough to bring our Corn and Fruits to perfection, and therefore if the heat we have in Summer, were no greater than it is now about the 10th of *March*, or the 11th of *September*, the Ground would not be able to produce any vegetables

getables to supply us with food, so that all of us must have changed our Climate for some more fertile Soil which receives more of the Sun's influence.

This may serve to shew how vain and false the Theorist's assertion is, that the primitive earth had its *axis* perpendicular to the plane of the *ecliptick*, and that this position is so far from being the best it could have, that it may be justly reckoned among the worse sort of positions. I come now to shew the great advantages we reap by the present position of the Earth, and how apt it is to serve the ends for which it was designed by its wise contriver.

Kepler in the above mentioned book tells us, that the earth was designed a place for those things which are liable to Generation and Corruption, and therefore it was by no means fit that the Sun should shine upon every part of it throughout the year with an equal tenour and force, but there ought to be such alterations and changes of his heat as are necessary to produce the design'd effects, for it is plain that different degrees of heat are requir'd for the production and ripening of most

Plants, the heat that is requisite for the first growth of a vegetable, not being sufficient for the ripening and perfecting the seed thereof, and that degree of heat which is necessary for bringing the seed to perfection, would quite wither the green and tender herb.

Now all this is obtained by the present position of the Earth, and the inclination of its *Axis*, to the plane of the *Ecliptick*, for from thence arises the variety of Seasons, and different degrees of heat and cold. We perceive in the Spring time, that we have the heat of the Sun still increasing in such a measure, as the Plants require for their nutrition and growth. At last the Sun arrives at his greatest *meridian* height, and then the Plants bring forth their Seeds which grow every day more and more perfect and then are fully ripe and fit for food, and when the Sun has performed his work in our part of the World, he returns again to the tropick of *Capricorne*, to make room for the Snow and Ice which comes in the Winter for the moistening and preparing the earth for a new Crop. And tho in the *Torrid Zone*, they never have any Snow or Ice, yet at the time of the year when the

the Sun is *vertical* to them, there falls such a quantity of rain, as not only cools the Air, and makes the Heat of the Sun tolerable, but also fattens the ground and prepares it for the production of fruits.

But there is one more considerable advantage which we reap by the present position of the earth which I will here insert: because I do not know that 'tis taken notice of by any. And it is that by the present inclination of the earths *axis* to the plane of the *ecliptick*, we who live beyond forty five degrees of Latitude, have more of the Suns heat throughout the year than if the Sun shined alwayes in the *equator*, that is if we take the summ of the Suns actions upon us both in Summer and Winter, they are greater than its heat would be if it moved always in the *equator*, or which is the same thing, the aggregate of the Suns heat upon us while it describes any two opposite parallels, is greater than it would be if in these two dayes it described the *equator*, whereas in the *Torrid Zone*, and even in the temperate, almost as far as forty five degrees of Latitude, the summ of the Suns heat in Summer and Winter is less

than what it would be were the *axis* of the Earth perpendicular to the plane of the *ecliptick*.

I know Dr. Bently in his last Lecture for the *Confutation of Atheism*, asserts that tho the *axis* had been perpendicular, yet take the whole year about we should have had the same measure of heat we have now. But I am not surpris'd to find an error of this nature asserted by one who as it appears is not very well skilled in *Astronomy*; for, in the same Lecture, he confidently saies, that *'tis matter of fact and experience that the Moon alwaies shews the same Face to us, not once wheeling about her own Centre,* whereas 'tis evident to any one who thinks, that the Moon shews the same face to us for this very reason, because she does turn once, in the time of her period, about her own Centre. But it were to be wish'd, that great Criticks would confine their Labours to their Lexicons, and not venture to guess in those parts of Learning which are capable of demonstration, for this is our present case, and I undertake to shew, that we who live in this part of the World, and have greatest need of the Suns heat, have more
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of it take the whole year about, than if the Sun moved continually in the equator, whereas they that live in the *Torrid Zone* and in places near them, and who are rather too much exposed to the heat of the Sun, than too little, have by this means less of his heat than they would have had the earth observed a right position.

I think this consideration cannot but lead us into a transcendent admiration of the divine wisdom, which has placed the earth in such a posture as brings with it several conveniences beyond what we can easily discover without study and application, and I make no question, but if the rest of the works of nature were well observed, we should find several advantages which accrue to us by their present constitution which are far beyond the uses of them that are yet discovered, by which it will plainly appear that God hath chosen better for us than we could have done for our selves, but to return to our assertion which I design to prove by the Canon invented by that excellent Geometer Mr. *Edmund Halley* in the *Phil. Trans. Numb. 203. viz. That the Sum of the Sines of the Suns Meridian Altitudes in any two opposite*

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posite parallels, being multiplied into the Sine of the semidiurnal Arch, and thereunto adding in Summer, or subtracting in Winter, the product of the length of the semidiurnal Arch, (taken according to Van Ceulen's Numbers) into the difference of the above said Sines of Meridian Altitudes: the Sum in one case, and difference in the other shall be as the Aggregate of all the Sines of the Sun's Altitude, during his appearance above the Horizon in the proposed day. Thus that I may use Mr. Halley's own example. Let the Solstitial Heat in \odot and γ be required at London, Lat. $51^{\circ} 32'$.

38° in $2^{\circ} 8'$ Co - Lat.
 $23^{\circ} 39'$ Decl. \odot
 $61^{\circ} 57'$ 58° Sinus $= 9,882674$
 $14^{\circ} 02'$ 58° Sinus $= 5,258257$
Summa $1,140931$
Diff. $1,624417$
Diff. Ascen. $33^{\circ} 11'$
Arc. Semidi. $123^{\circ} 11'$
Arc. Semidi. by $56^{\circ} 49'$ Sin. 638923
Arc. $2,149955$
Arc. by 991683
Then $1,140931$ in $638923 + 624417$
in $2,149955 = 2,29734$ And $1,140931$
in

in, 886929—, 624417 in, 991638=33895
So that the Sun's action will be as 2,29734
in the day of the Summer Solstice and
as 0,33895 in the Day of the Winter Sol-
stice.

According to this Canon I have
computed the Heat of the Sun for every
five degrees of its declination both *North*
and *South*, at the Latitude of 51 degrees
as in the following Table,

The Sun's Declin.	Heat in North Declination.	Heat in South Declination.
0	1,25864	1,25864
5	1,47393	1,04839
10	1,692937	,845079
15	1,91489	,65091
20	2,13919	,46916
23½	2,2991	,37980

By which it will appear that the heat
of the Sun in the Latitude of 51 de-
grees while it describes by its diurnal
motion any too opposite parallels, is
greater than if the Sun these two days
had described the *equator*, as for exam-
ple, the heat of the Sun in the 20th de-
gree of *North* declination is as 2,13919
and in the 20th degree of *South* declina-
tion

tion as 46916 which two added together make, 2, 60135 which is more than double the number 1, 25864 which represents the heat in one *equinoctial* day, and so in all the rest of the parallels. After the same manner the action of the Sun in Summer and Winter may be easily Calculated for any Latitude or distance from the æquator, by which it will plainly appear that the heat of the Sun while it moves from *Aries* to *Libra*, that is during the time it runs through the six *Northern* signs together with its heat while it moves from *Libra* to *Aries* again, in the six *Southern* signs, is greater to us who live beyond the 45th degree of Latitude, and consequently stand most in need of the Suns heat, than it would be had the *axis* of the earth stood at right angles with the plane of the *ecliptick*, by which the Sun would seem to move in no other circle than the *equator* as the Theorist imagines it did before the Flood.

The next thing I am to make out is that the heat of the Sun in the *Torrid Zone*, and even in the two temperate *Zones* almost as far as to the 45th degree of Latitude is less than it would have been had the Theorist's position of the earth

earth been the true one and this is manifest by the following Table Calculated by Mr. *Halley* in the above mentioned *Philosophical Transactions*.

Lat.	Sun in V ♈	Sun in ♊	Sun in V ♎
0	20000	20290	18341
10	19696	18341	15834
20	18794	21737	13166
30	17321	22651	10124
40	15221	23048	6944
50	12855	21991	3798
60	10000	22773	1075
70	6840	23543	000
80	3473	24673	000
90	0000	25055	000

Where it plainly appears, that the aggregate of the Suns heat while he is in ♊ and ♎ and so in any other two opposite parallels, is less to those who live in the *Torrid zone*, than if the Sun by his *diurnal* motion had described continually the *equator*.

Thus we see how admirably convenient the present position of the earth is upon several accounts, and how excellently it is fitted to our use and purposes above any other that we can imagine,

gine & therefore we can never enough admire the Divine wisdom for such an excellent contrivance, This shews us also how much we ought to regard final causes in *Natural Philosophy*, which in things of this nature are by far more certain and convincing than any of the *Physical* and *Mechanical* ones which the Theorist brings to prove the truth of his assertion which have brought him into many strange and dangerous errors, it being just that God Almighty should deliver these men up to follow strange delusions, who neglecting to proceed upon final causes the true principles of *Natural Philosophy*, and to square their notions according to the Divine Revelations contained in Holy Scripture have followed the wild and extravagant fancies of their own imaginations.

Another Argument which may be brought to convince the Theorist that the *axis* of the earth was at first inclined to the plane of the *ecliptic* as it is now, is, that it is certain by observation that *Saturn* and *Jupiter* (whom the Theorist will allow to have suffered no Deluge as yet) have their *axis* not perpendicular but inclined to the planes of their *orbits*, and the position is true of all

all the other Planets as far as they can be observed, and therefore it is reasonable to suppose that the same must have been the position of the earth at the beginning, for where universally the same effect is observed, there it will be agreeable to the maxims of *Natural Philosophy*, to assign the same cause, nature being uniform and not taking different methods to perform the same thing.

It remains now that I examin the reasons the Theorist alledges to prove that the earth before the flood had its *axis* perpendicular to the plane of the *ecliptick*; it is says he, the immediate result of gravity or libration that a body freely left to its self should settle in such a posture as best answers to its gravitation, and this earth whereof we speak being uniform and every way equally ballanced, there is no reason why it should incline at one end more than at the other towards the Sun, as if you will suppose a Ship to stand *North* and *South* under the *equator* if it was equally built and equally ballanced it would not incline to one Pole more than to the other but keep its *axis* parallel to the *axis* of the earth, so those great Ships that sail about the Sun once in so many

ny years whilst they are uniformly built and equally poised keep steady and even with the *axis* of their *orbits*, but if they loose that equality and the centre of their gravity change the heavier end will incline more towards the centre of their motion, and the other end will recede from it, so particularly our earth which makes one in that airy fleet when it escaped so narrowly being shipwrackt in the great Deluge, was however so broken and disordered that it lost its equal poise and thereupon the centre of its gravity changing, one Pole became more inclined towards the Sun and the other more removed from it, in which skew posture it hath stood ever since.

Here the Theorist puts his false reasoning in fine words, and dresses it out in gayety according to the present mode, that it may go the smoother off, but at the same time he shews us how little he is skilled either in *Astronomy* or *Geometry*, for he tells us in one place, that the earth *stands inclined to the Sun or the Ecliptick*, but how a sphere can be inclined to a plane passing through its centre is far beyond my *Geometry* to conceive. I am sure he will find no such thing said by the Geometers or the

the Astronomers before him, but he may be easily pardoned for this small error, because he *meant well*, viz. that the *axis* of the earth was inclin'd to the plane of the *Ecliptick*, with which it makes an angle of $66^{\circ}\frac{1}{2}$. But he has committed a far greater blunder than this which is not so easily to be forgiven him, for a World-maker ought at least to understand something of Astronomy and of the *Copernican* system which he embraces, but it is plain that he does not know the Elements of that system, since he asserts that one Pole of the earth is more inclined to the Sun than the other, this is a position I never heard was given to the earth before. I wish he would inform us which of the two Poles is most inclined to the Sun, for I am sure *Copernicus*, *Kepler* and *Gallileo* the first revivers of the *Pythagorean* system never said any such thing, they held that both Poles were equally removed from the plane of the *ecliptick*, the *axis* which joins them making with it an angle of $66^{\circ}\frac{1}{2}$ and keeping a position alwayes parallel to it self and therefore whatever inclination one Pole had at any time of the year to the Sun, the opposite Pole would

would have the same inclination at the opposite time of the year, and therefore both Poles are equally inclined to the Sun.

'Tis true indeed that if one hemisphere were heavier than the other, the heaviest Pole would always look towards the Sun to which it gravitates, and by consequence there would be no parallelisme observed in the *axis* of the earth, for if there were a Globe swimming in water, one of whose Poles were heavier than the other, it is demonstrable that the heaviest side would always be towards the centre of the earth, but since the earth does always keep its *axis* parallel to it self, and by that means makes the variety of seasons which otherwise would not happen, I think it a demonstration that the Theorist's opinion in this point is false and ridiculous. For if at the Deluge the earth had lost its equal poise, and its Centre of gravity had been altered as he will have it, the true effect of this alteration would be that the Pole which was next to the Centre of gravity had been always turned towards the Sun, and the people living near it had injoyed a perpetual Summer

mer and one continued day without any night, whilst those in the opposite Pole had lived in perpetual darkness, Frost and Snow, having but one eternal Winter without any vicissitude of seasons. These therefore being the necessary consequences of such a change of gravity in the earth as the Theorist imagines, and since none of them did ever happen to it, but the earth does still keep its *axis* parallel to it self; I think it is demonstratively evident that the earth received no such *shock* by the Deluge as was sufficient to alter the Centre of its gravity, and consequently the position of its Poles in respect of the Sun.

'Tis true, a sphere put in *equilibration*, and made turn round about a point without any other motion, necessarily keeps all its diameters parallel to themselves, and by consequence the *axis* which is one of them must also be parallel to its self, for since the time of its revolution is determined, it will perform its period in that time with the least motion possible, which is only when all the diameters of the sphere in all parts of its *orbit* are parallel to themselves as is demonstrated by the Geo-

meters, Nature generally taking the shortest courses in all its operations; at least it takes that one and determinate method for performing its work, which the Philosophers call the *unicam in natura*, I wonder therefore why some should make a third motion for the Earth, whereby it keeps its *axis* alwayes parallel to it self, for this is rather the effect of rest than any new motion; for it is not the parallelism, but the declination of the *axis* from exact parallelism, (by which the Stars seeme to move tho very slowly according to the series of the signs) which ought to be called a new motion.

But I will pass from this Subject, and consider the Theorists Argument for the right position of the Earth drawn from its *equilibration*, which he sayes is the immediate result and common effect of gravity or libration. For a Body sayes he freely left to its self in a fluid medium will settle it self in such a posture as will best answer to its gravity, and the Earth being uniformly ballanced, there is no reason why it should incline at one end more than at the other towards the Sun. This he illustrates by the similitude of a Ship
equally

equally ballanc'd, and placed *North* and *South* under the *equator*. But after all this Argument and Similitude, I can see as yet no reason why the *axis* of the Earth should be perpendicular to the plane of the *Ecliptick* more than any other of its diameters, for it is demonstrated by the writers of *Hydrostaticks*, that a sphere whose centre of Gravity is the same with its centre of Magnitude if put in a fluid of the same specific gravity with it self, will retain any given position, and therefore there can be no reason drawn from the earths gravity or equilibration why the position of its *axis* should be perpendicular to the plane of the *Ecliptick* rather than any other of its diameters.

BOOK II. CHAP.

CHAP. V.

Of Rivers.

THE Theorist having represented to us the first Earth as a smooth regular and uniform body without Mountains and without a Sea; In the 5th Chap. of his second book he starts a great difficulty how it was watered, from what causes, and in what manner, how could Fountains rise or Rivers flow in an Earth of that form and nature? he has shut up the Sea with thick walls on every side, and taken away all communication that could be 'twixt it and the external earth, he has removed all the Hills and Mountains where the Springs use to rise, and whence the Rivers descend to water the face of the ground, and lastly, he has left no issue for these Rivers, no Ocean to receive them, or any place to disburthen themselves into. So that his new found World is like to be a dry and barren wilderness, and so far from being Paradisaical that it would scarce be Habitable.

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These indeed are great difficulties, and the Theorist has acknowledged them to be such, for he says there was nothing in his whole Theory that gave so rude a stop to his thoughts as that part of it concerning the Rivers of the first Earth. But as the difficulties are great, and as one would think insuperable, so no doubt the glory that redounds to the Theorist must be nothing less, if they be clearly taken away.

To understand therefore what the state of the primitive Rivers and waters would be, he finds it necessary to consider and examine how the rains fell in the first Earth, and he tells us that the order of nature in the Regions of the air would be very different from what it is now; there could be no violent motions there, nor any thing that proceeded from extremity of cold, as Ice, Snow, or Hail, and as for Winds, they could neither be *impetuous* nor irregular in that Earth of his, seeing there were no Mountains, nor any other inequalities to obstruct the course of the vapours, nor any unequal seasons, nor unequal actions of the Sun, but as for waters, meteors, dew, and

rain, there could not but be plenty of these in some part or other of that Earth: for the action of the Sun in raising vapours was very strong, and very constant, and the Earth was at first moist and soft, and according as it grew more dry, the rayes of the Sun would pierce more deep into it, and reach at length the great abyss which lay underneath and was an unexhausted storehouse of new vapours. Now the same heat which extracted these vapours so copiously, would also hinder them from condensing into rain in the warmer parts of the Earth, and there being no mountains or contrary winds or any such causes, to stop or compress them, they would take their course where they were least resisted, which is towards the Poles and the colder regions of the Earth; for *East* and *West*, they would meet with as warm an air, and vapours as much agitated as themselves, which therefore will not yield to their progress that way, but *North* and *South* they will find a more easy passage so that the concurrence of vapours which were raised chiefly about the Equinoctial and middle parts of it would be towards the extreme parts or

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the Poles. When these vapours thus driven by the heat of the Sun were arrived in the cooler Regions near the Poles they would be condensed into rain, for wanting there the cause of their agitation, namely the heat of the Sun, their motion would soon begin to languish, and they would fall close to one another in the form of water.

Thus he thinks he has found a sufficient source for waters in the first earth, which would never fail, neither diminish nor overflow. But tho' he esteems this an inexhaustible store-house, and an easy way to furnish Waters, yet if it be narrowly examined he will find it not in the least sufficient for such an effect.

For first according to his own hypothesis there could be no Rivers for a long time after the formation of the Earth till the Sun had crackt the outward crust thereof, and its heat had reacht the great abyss which the Theorist must needs own will require a very considerable space of time, one would think it would be several hundreds of years before the Suns heat could perform such an effect, during all which time the inhabitants of the

Earth must be without waters and rivers, and lead very sad and uncomfortable lives. Is this the fruit of the Golden Age? or is this consistent with the happiness of the antediluvian Fathers? in my opinion it is directly contrary to the Scriptures, for they give us an account of rivers immediately after the formation of the Earth.

But *2dly*, I will hereafter prove that the Sun's Beams did never yet reach so deep in the Earth as the thickness of the first crustation must have been, and consequently there never could arise any vapours from the abyss to furnish the rivers.

3dly, Supposing the heat of the Sun to have crackt the crust, and to have raised vapours from the abyss, yet it is certain it could not do it in such a quantity as would be sufficient to furnish the Earth with waters. And now the Theorist will tell us, what can be more sufficient than the whole orb of water, sure this would do or else nothing could, this he will say is an inexhaustible treasure that the rivers could never drain, and therefore there was no fear of want of waters from thence. Yes there was reason to fear it
very

very much, for supposing that there was enough in the abyſs, yet perhaps the action of the Sun would not raise so much as would be sufficient to water the Earth, so there may be enough of Gold in the bowels of the earth, but if we cannot come at it we shall never be the richer for it.

That I may examine this, I will suppose that the mouths of these cracks which the Sun is said to have made by its heat to be a ¹⁰⁰⁰ part of the surface of the earth, this will exceed 2600 square miles which I think is as much as the Theorist can reasonably allow them, for if it were but one continued crack round the equator of a miles breadth it would not exceed 25000 miles.

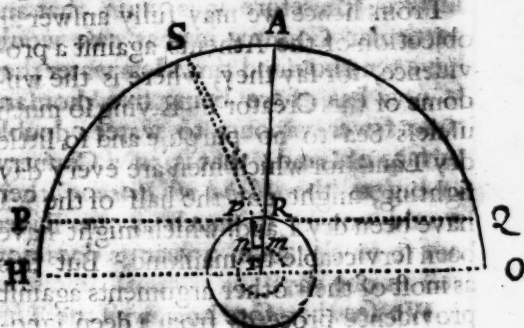
And I will suppose with the Theorist that one half of the surface of the present earth is Land and the other is Sea, and by consequence the mouths of those pits or cracks must be one five thousandth part of the whole of the now Ocean. Now it is evident that vapours drawn by a determinate heat from any quantity of water in a determinate time are alwayes proportionable to the surface of that water: for
from

from a double surface there will be exhaled a double quantity of vapour, from a triple surface a triple quantity of vapour, and so on. Therefore the surface of the Sea being 5000 times bigger than the mouths of these cracks, there will be exhaled from it 5000 times more water than what in that case could be drawn from the abyss. And therefore if the whole crust of the Antediluvian earth were but of the same bigness with our now dry land, it would have but one five thousandth part of the water to furnish it, that our present earth has, but because according to the Theorist, the surface of the dry land was then twice as big as it is now, there being at that time no Ocean which takes up one half of the surface: therefore it is plain that any particular Country in that case would have ten thousand times less water than it now has, there being five thousand times fewer vapours to water a double surface of Land; that is, in a Country, as big as the *Island of Britain*, there would not be so much as one River, nor so much rain in a year as does now fall in one day.

We see therefore how well the Theorist

orist has watered his Antediluvian earth from the inexhaustible treasure of the abyfs as he calls it. For however immense that great store-house was, yet still there would be a great scarcity of water on the surface of the earth.

Not. Except we will suppose the heat of the Sun in the primitive world considerably greater than it is in our earth, there must be less water drawn from the abyfs than what I shewed from the former Calculation, and that because the Sun could not shine so long upon the surface of the abyfs thow the cracks as it does now upon the Sea, by reason the crust of the earth would intercept all the rayes of the Sun till it came to be of a considerable height as is plain by this Figure.



Where

Where if *S* represent the Sun in the equator, and *PQ* the sensible Horizon, *mn* the surface of the abyss opened by the pit *PnmR*, the Sun must be at the height *HS* above the Horizon before its heat can reach the surface of the waters. The heat also upon the surface *nm* would not be so great by reason of the cold orb of earth which did incircle it. And upon these and some other accounts the Sun would not raise so much water from the abyss as it does now from the same quantity of surface in the Sea, but I will not take any advantage of these considerations leaving them to be a recompence for the greater influence of the Sun which the Theorist says it had upon the Antediluvian earth.

From hence we may fully answer an objection of the Atheists against a providence, for say they, where is the wisdom of the Creator in having so much useless Sea to no purpose and so little dry Land, for which men are every day fighting, might not the half of the Sea have been dry Land. which might have been serviceable to mankind? But this as most of their other arguments against providence proceeds from a deep ignorance

rance of Natural Philosophy. For if there were but half the Sea that now is, there would be also but half the quantity of vapours, and consequently we could have but half so many Rivers as now there are, to supply all the dry Land we have at present and half as much more. The wise Creator therefore, did so prudently order it, that the Sea should be large enough to supply vapours for all the Land, which it would not do if it were less than it now is.

But I will suppose with the Theorist, that there was a quantity of vapours exhaled by the heat of the Sun from the abyss sufficient to furnish plentifully the whole earth. Yet still there is a great doubt how Rivers could be formed: for what wayes could the vapours take their course to be condensed and form Springs if there were no winds to carry them, certainly they would stagnate near the mouths of the cracks and leave the rest of the earth never a whit the better for them, and every one that wanted water must go as far as the *equator* to fetch it. No says the Theorist there was no need for that, the vapours being very much agitated

agitated and rarified by the heat of the Sun, and being once in the open air, their course would be that way where they found the least resistance to their motion; and that would certainly be towards the Poles and colder regions of the earth, for *East* and *West* they would meet with as warm an air, and vapours as much agitated as themselves which therefore would not yield to their progress that way: But towards *North* and *South* they would find a more easy passage, the cold of these parts attracting them as we call it, that is, making way to their motion and dilatation without much resistance, as mountains and cold places usually draw vapours from the warmer.

Here is a new use or employment the Theorist has found for the Mountains and Cold to be Gentlemen-ushers, for the vapours, and make way for their motion. He had told us before that the Cold and Hills attracted vapours, but because that word was not Philosophical, (being exploded and ridiculed by those who call themselves new Philosophers) he explains himself and tells us by attraction he meant the making way for their motion and dilatation; but

but how a Mountain can make way to the dilatation and motion of vapours is far beyond my pitch of understanding, to me it seems reasonable that they should resist both, and hinder the vapours either from moving forward or dilating themselves. Sure I am, Cold is so far from being any wayes conducive to the dilatation of vapours, that it does alwayes condense them, as is plain by cold stone walls which alwayes condense the vapours that fall upon them.

But the vapours sayes the Theorist, are very much agitated by the heat of the Sun, which gives them their motion; and therefore they would take their course towards the Poles where they find the least resistance. What other motion the heat of the Sun can give them, but upwards I cannot imagine, for by it they are raised and made specifically lighter than the air in which they swim, and therefore by a known principle in Hydrostaticks they must rise till they come to air of the same gravity with themselves, but then what should drive them to the Poles? their great agitation sayes he, and the little resistance they find that way, the air
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in the *East* and *West* being more agitated than that towards *North* and *South*, and therefore will more resist their motions.

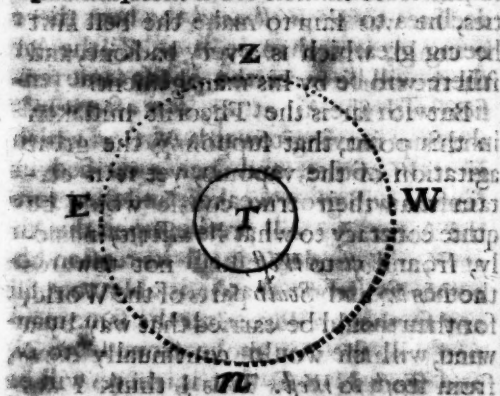
This is a very dark answer, for I cannot conceive why the air upon the *North* or *South* side of an atome of vapour should be more agitated than that upon the *East* and *West* side, for sure I am, there is the same degree of heat on all sides of it, and therefore upon that account it should find an equal resistance every way. Nay the Theorist, or such an other Philosopher might with as good reason have proved, that their course would have been only *East* and *West*, for there the air was very much rarified and made thin by the heat of the Sun, the air towards *North* and *South*, not being so much rarified was thicker, and therefore would resist more, as water which is a thicker medium does more resist the motion of bodies in it than air. This seemes to me to be a much better grounded opinion than the Theorists, tho' both of them are absolutely false, and may be disprov'd by the very same reasons, for how can any man fancy that vapours only driven by the heat of the Sun, would travel
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some thousands of miles through a fluid body of air as dense as themselves, this seems to be against the common notions of every man, and therefore I think needs no particular calculations; I cannot but believe that the Theorist did see these absurdities, since they are so very palpable, but finding no way to extricate himself from these difficulties, he was fain to make the best shift he could, which is a very bad one, and still the worse by his management.

But so far is the Theorist mistaken in this point, that supposing the great agitation of the vapours, yet it is certain that their true course would be quite contrary to what he asserts, namely, from *East to West*, and not towards the *North* and *South* parts of the World, for they would be carried that way by a wind, which would continually blow from *East to West*. This I think I am able to prove demonstratively thus.

It is well known to all the Philosophers, that the air is a very elastick fluid body, so that being compressed with the weight of the incumbent atmosphere, it will endeavour to expand it self, and fill up a great space. If all the air therefore were equally dense or compressed,

prest, every part would equally resist another's pressure, and from thence there could arise no motion, but if we should suppose in this atmosphere one part thinner and its tension weaker than the rest, it is certain that the circumambient air, whose force to expand it self is stronger, will rush in upon it, and keep up an equilibrium in the air.



Now suppose *E Z W N* represent the Orb of Air, which surrounds the earth *T*, and the Sun were shining directly upon the Air at *Z*, which therefore by the great heat of the Sun will be very considerably more rarified and expanded than the Air at *E*, but after
wards

wards the Sun shifting to the *West*, and coming to shine directly upon *W*, the Air at *Z* being rarer than the Air at *E*, and the heat of it being gone, its tension or force to expand it self, will not be so strong as the tension of that which is at *E*, and therefore the Air at *E*, will rush into *Z*, and keep up the equilibrium. Thus also when the Sun declines to *W Westward*, the heat there being greater than it is at *Z*, the Air there will be rarer tho of the same tension with the Air at *Z*, but afterwards the Sun moving towards *N*, that which is at *W* cooles, and being rarified its tension will grow weaker, and therefore the Air at *Z*, will press in upon the Air at *W*, and condense it till its tension becomes so strong that it is able to resist any further pressure; after the same manner will the Air move from *W* to *N*, and from *N* to *E*, that is, there will be a continual wind blowing from *East* to *West* according to the motion of the Sun; for wind is nothing but a strong stream of the Air moved according to such a direction. But this is testified by the experience of all who Sail toward the *Indies*, for they find a wind in the *Atlantick* and *Ethiopic* Oce-

ans which continually blows from *East* to *West*.

Since therefore this is clearly agreeable both to reason and observations, there is no further doubt to be made of it. The wind therefore in the *Torrid Zone* of the primitive earth blowing continually from *East* to *West*, must of necessity carry with it all those bodies which swim in it, and are of the same density with it self; All the vapours and exhalation therefore that can be drawn either from the abyss or earth by the heat of the Sun, since they swim in an Air of the same density with themselves, must be carryed from *East* to *West* by the motion of the winds, which is alwayes directed that way.

And now I hope it will be plain even to the Theorist himself (tho men are seldom convinced of the fallhood of their own notions) that the vapours which are raised by the Sun under the *Torrid Zone* of the primitive earth could never have reached either of the Poles, and therefore most part of the Inhabitants of the earth must still have been without water since 'tis impossible any supplies could be brought to them from the *Equator*.

C H A P. VI.

Of the Figure of the Earth.

THE Theorist as he thinks having found a sufficient stock of waters for the supply of all the Rivers in the earth, does now enter upon the solution of another great difficulty, which is to shew, how in a smooth and regular earth the waters could run, and what way they would take their course after their arrival at the Poles in vapour; for since there were no Hills, nor Mountains, nor high Lands, in the first Earth, the vapours falling in the Frigid Zones and towards the Poles, there it seems they would stand in Lakes and Pooles, having no descent one way more than another. The Theorist therefore to take off the objection, will have the earth not to be of an exact Spherical, but an Oval figure, in which he sayes it is manifest that the Polar parts are higher than the *Æquinoctial* that is more remote from the Centre as appears by his figure, and this he tells us will do the business, For by that means the vapours which fall at

the extream parts of the earth will have a continual descent towards the middle parts thereof, and by consequence it will be a sufficient descent for the running of Rivers.

Now I will readily grant that the figure of the earth is not Spherical but Spheroidical, but I can see no reason why it should be an oblong Spheroid and not a broad one, for it may be of a Spheroidical figure, tho the Axis of it were shorter than the Diameter of its equator, and if it were so, I would fain know by what means the vapours would flow from the Poles to the Equator.

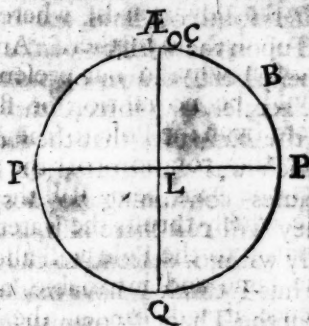
But the Theorist gives us an account how the Earth came to be formed after the fashion of an oblong Spheroid. 'Tis true says he, if the Earth were as fluid a *substance* as it was in the Creation and stood immovable without turning round its own Axis it would certainly settle it self into a Spherical figure, but because it turned very swiftly round its Axis, the Fluid by that agitation would indeavour to recede from its Centre of motion, and form it self into a figure very nearly Oval, as we see in the Sea, or in any Lake when the waters are driven by the wind upon

on the Land the Waves extend themselves in length, so in our watery Globe which is turned about its own Axis, the whole bulk of water under the equator being much more agitated than that which is towards the Poles (where the fluid in its diurnal motion describes lesser circles) it will endeavour to recede from the Centre of its motion, and because it cannot get quite off and fly away, by reason of the Air which every way presses upon it, and the straitness of its Orb in these places, neither could it flow back without a great check and resistance from the same Air, it could not otherwise free it self than by flowing towards the sides, for waters which are hindered in their motion will take the easiest course they can have. Now from this detrusion of the waters towards the side, the parts towards the Poles must come to be much increased, and those towards the equator discharged of abundance of water, which otherwise would have layen upon them, and by consequence the earth must have been of an Oblong or an Oval figure.

Now supposing all this reasoning true and solid (as indeed it is not) that

the earth by its circum-rotation round its Axis, had formed it self into the figure of an Oblong Spheroid. Yet still I cannot conceive how this will help the matter, for even in that case, the waters would not flow from the Pole to the Æquator: Yes they will sayes the Theorist, since all fluids will descend as far as they can, and this is the only way of descent by which they come nearer to the Centre than by any other. 'Tis certainly true indeed that all fluids will descend continually till they meet with some obstacle which resists their motion downwards, where they must stop and go no further. And this is the reason why in our present case there could be no motion or flux of the Rivers from the Pole to the Æquator. For the rotation of the earth round its one Axis being still the same, the cause which thrusts the water from the Æquator to the Pole will also continue the same and invariable, and by consequence it will hinder the water from returning again towards the Æquator. And therefore supposing that the Earth were formed into an Oval figure, yet could there not be any course for Rivers; for only so far would the water

ter ascend towards the Poles, till the force which protruded it that way came to be in an *Æquilibrium* with its gravity, and there it would stop neither ascending any further, nor descending again as long as the same cause continued to act; that is, as long as the Earth turns round its own Axis in the space of twenty four hours, but if the Earth should cease to move round, then indeed in that case and no other, the water would return to the *Æquator*. For let the Figure,



PEPQ represent the Earth *P, P* the two Poles, and *ÆQ* the *Æquator*, and *B* a Body upon the surface of the Earth, I think it is evident that the
Body

Body B will so far ascend towards the Poles, till the force which protrudes it that way be in æquilibrium with the force which draws it to the æquator: for if at B one were greater than the other, for example, the force by which it is drawn to the Poles, were greater than its gravity, or its tendency towards \mathcal{A} , then it would still move on towards the Pole, till both forces come to act equally and there it would rest, as long as these two forces continued in *Æquilibrium* which must be so long as the Earths diurnal motion lasts. Now whatever Bodies either solid or fluid, are brought and laid upon the surface of the Earth at B, these being drawn or pusht with the same accelerating force, either to the Pole or the *Æquator*, that the first fluid had, which was constituted at B, the same causes continuing to act upon both, they will rest there also, and consequently will not descend to the *Æquator*. Thus I think I have made it evident from the Theorists own principles, and his Oval figure of the Earth, that there could be no course of Rivers in the Antediluvian world, if his Theory were true, and therefore seeing there were Rivers then as well as now, for
he

he himself has acknowledged them, and it is plainly asserted by the Scriptures that they were from the beginning, I think it is a certain demonstration that the whole account of his Antediluvian Earth is false and Chimerical.

I come now to examin the Theorists reasons by which he proves the Earth to be of an Oblong Spheroidical figure. He tells us that the fluid under the aquator being much more agitated than that which is towards the Poles which describes in its diurnal motions lesser arches, and because it cannot quite get off and fly away by reason of the Air which every way presses upon it, it could no other wayes free it self than by flowing towards the sides, and consequently form the Earth into an Oval figure.

That the Reader may observe how excellent the Theorist is at drawing conclusions, I will put this reasoning in other words thus. All Bodies by reason of the Earths diurnal rotation, do endeavour to recede from the Axis of their motion; but by reason of the pressure of the Air, and the straightness of the Orb, they cannot recede from the Axis of their motion, therefore they will move towards the Poles where

where they will come nearer to the Axis of their motion, as if you would suppose a Body at the *Æquator* which doth endeavour to recede from the Axis of its motion, but because it cannot quite fly off and get away, therefore it will move towards the Poles, that is, it will come nearer to the Axis of its motion than if it had stayed at the *Æquator*. It seemes to me that the Theorist in this part has endeavoured to give us a proof of his great skill in Logicks, for he from a possible supposition, has endeavoured directly to prove its contradictory, that is, because all Bodies do endeavour to recede from the Axis of their motion, therefore they will endeavour to go to the Axis of their motion. But I will now examine his Argument more particularly, and first I will grant to the Theorist, that all Bodies turned round about any Centre do endeavour to recede from it and fly off in the tangent. For this is both evident to reason and experience; but since the Air does alwayes move round the Earth, it is plain that it will also endeavour to recede from the Centre of its motion, and by consequence, it will be no hinderance to the

the

the water to do the same, neither can it be said, that the straitness of the Orb will hinder the fluid from receding, since there is no reason to assign any such strait limits to our Globe; for our Air is not inclos'd with walls, but beyond our Atmosphere there lyes a free and open space: besides if there were any such straitness, without doubt it would be every where equal and the same, and by consequence, as it hindered the fluid from rising at the Equator, so it would also hinder its rising at the Poles, and then there would not in that case be any Oval figure at all.

I am sure the Theorist can give no reason why he should make the Air resist the motion of the fluid upwards at the Equator, and yet yield to its motion upwards at the Poles, since it is certain that the Air presses as much one way as another: it will by the same force hinder a fluid from rising at the Pole, by which it resisted its rising at the Equator, and therefore it is plain, that the Earth could not upon any such account be of an Oblong Spheroidical figure, whose surface at the Equator is nearer its Centre than its Poles are.

So

So far is the Theorists Opinion distant from truth in this point, that from the same very principle of a Centrifugal force it does evidently follow that the surface of the Earth towards the Equator is higher or further distant from the Centre than it is at the Poles, which is directly contrary to that figure which he supposes it had in its primitive state. Now to prove this, I wil suppose first, that at the beginning of the world the Earth was fluid and spherical, but afterwards God Almighty having given it a motion round its own Axis, all Bodies upon the Earth would describe either the Equator, or Circles parallel to the Equator, and by consequence all would endeavour to recede from the Centre of their motion.

It is to be here observed, that if a Body doth freely revolve in a Circle about a Centre as the Planets do about the Sun, that its centrifugal force, (or that force by which it is drawn towards the Centre) is alwayes equal to its centrifugal force by which it doth endeavour to recede from the Centre: for the force which detains a Body in its orbit must be equal to the force, by which it endeavours to recede from
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its orbit and fly off in the tangent. This may be clear by the example of a Body turned round a Centre by the help of a thread which detains the Body in its orbit; the thread being stretched by the motion of the Body will endeavour to contract it self equally towards both ends by which it will pull the Centre as much towards the Body as it doth the Body towards the Centre.

Now this Centrifugal force is alwayes proportional to the periphery which each Body describes in its diurnal motion by the first Theor. of *Hugenius De vi Centrifuga* so that under the Equator which is the biggest circle the centrifugal force would be greatest, and still grow less as we approach the Pole where it quite vanisheth, there being there no diurnal rotation. And without doubt all Bodies having this centrifugal force by which they endeavour to recede from the Centre of their motion, would fly off from the Earth if they were not kept in their orbit, by their gravity, or that force by which they are pressed towards the Centre of the Earth, which is much stronger upon our Earth than the centrifugal force; and because the gravity
I upon

upon the surface of the Earth is alwayes the same, but the centrifugal force alters and grows less the nearer we come to the Poles; it is plain that the gravity under the æquator having a greater force to oppose it than that which is near the Poles will not act so strongly in the one place as in the other, and consequently bodies will not be so heavy under the æquator as at the Poles.

If the Circle EPQ represent the Earth, E the æquator and P, P the Poles, if C be a Body in the æquator, it is evident that it will be pulled by two contrary forces, namely that of its gravity which pulls it towards the Centre, and that of its centrifugal force which pulls it from it. Now if both these forces were equal it is evident it would go neither of these wayes; but if one were stronger than the other, it would move where the strongest force pulls it, but only with a velocity which is proportional to the differences of these two forces, and therefore it would not descend so fast as if there were no centrifugal force pulling against it. That is a Body in the æquator does press less towards the Centre than at the

See the Figure of the 105th Page.

Pole

Pole where there is no centrifugal force to lessen its gravity. Bodies therefore of the same density are not so heavy in one place as in the other.

Now in a spherical fluid, all whose parts gravitate towards the Centre, I think it is evident from the principles of Hydrostatics and fluidity, that all these Bodies which are equally distant from the Centre, must be equally prest with the weight of the incumbent fluid, and if one part come to be more pressed than another, that which is most pressed will thrust that out of its place which is least, till all the parts come to an equilibrium one with another, and this is known by a common and easy experiment, if you take a recurved tube as in the figure, and fill it with water or any other fluid, it will rise equally in both Legs of the Tube, so that the Surfaces *CE* and *FI* are equally pressed by the weight of the incumbent columns *BCED*, *GFIH*, but if one of the Legs of this Tube should

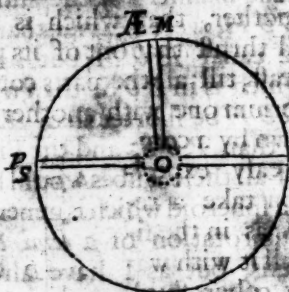


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be filled with oil, or some other lighter fluid, and the other with water, the lighter fluid will rise higher than the other, for otherwaies, these surfaces which are equally distant from the Centre could not be equally pressed.

Just so, if the Figure *PÆMPS* represent a fluid sphere, which we may imagin composed of a great many communicating Canals or Tubes, the fluid in every one of which presses upon the



Centre, now if the fluid in every one of these Tubes was of equal weight or gravity, it is plain that by that means they would be also of an equal height from the Centre; for by that means only would the Centre be equally pressed by the weight of all the Tubes; but

but if the fluid in the canal EOM were lighter than the fluid in the canal POS , it is plain that in this case the fluid POS pressing more on the Centre than the fluid in EOM , the surface of the fluid in the canal EOM will rise to a greater height or distance from the Centre, so that by its greater height which recompenses its lesser gravitation it will press equally upon the Centre, with the fluid in the canal POS . After the same manner * if the fluid in the canal GOH , were heavier than the fluid in the canal EOM , but lighter than that which is in POS , than would the canal, GOH be shorter than EOM but longer than POS , and the Figure composed of all these Tubes would be in the form of a spheroid which is generated by the circumrotation of a *semi ellipsis* round its axis, but as I have already showed that if EOM represent the semidiameter of the equator, that all Bodies in it are lighter than in POS , the Axis of the equator (we take the Diameters and Axis here not as pure Mathematical lines, but as small Canals or Tubes,) and just to those Bodies which are in the Tube GOH , I have prov-

-ovt. See the Figure in the next Page. most benno

ed to be lighter than those in POS , but heavier than the Bodies which are in EOM , the centrifugal force in GH , being less than that which is in EM , and there is no centrifugal force in the Poles, PS . It is plain therefore that the Tube EOM , will be longer than GOH , and GOH will be longer than POS , that is, the Diameter of the Equator will be longer than the Axis of the Earth, and consequently the Figure of



the Earth will be after the fashion of a broad spheroid which is generated by the rotation of a semi Ellipsis round its lesser Axis. This I hope will be sufficient to convince the Theorist of the falseness of his own assertion, since it is plain demonstration, that an Earth formed from a Chaos must have a ve-

ry different Figure from what he supposes it had.

But I will now proceed farther and inquire, how much the gravity is diminished at the æquator, or any other parallel by the centrifugal force, which all bodies acquire by being turned round the Earths Axis, that from thence we may endeavour to determin what proportion the Diameter of the Earths æquator has to its Axis, to Calculate which, I will first suppose that the mean semidiameter of the Earth is 39613800 *Paris* feet according to the late observations of the *French Mathematicians*, and since the Earth turns round its Axis in the space of 23 hours 56, for in that time the same meridian returns to the same immoveable point of the Heaven again (but the Sun in the mean time seeming to be moved a degree according to the series of the signs is the cause why there is four minutes more required, before the meridian can overtake him) from thence it follows, that a Body under the æquator moves through 142688 feet in the space of one second of time. Now according to the Theorem given us by Mr. *Newton* in his *Philosophiæ Naturalis principia Mathematica*

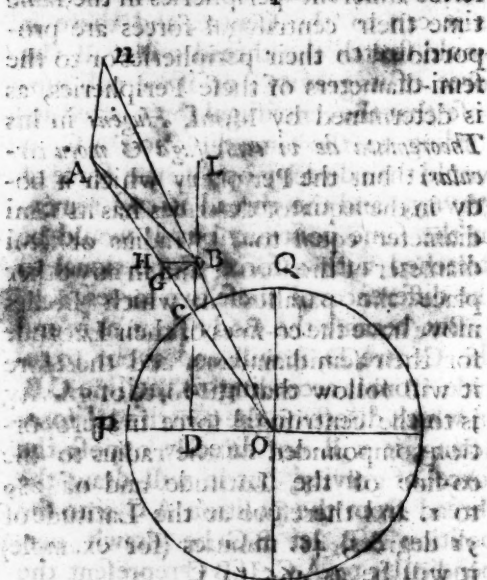
thematica Schol, prop. 4. Lib. 1. The centrifugal force of any body, has the same proportion to the force of gravity, that the square of the arch which a body describes in a given time divided by its diameter, has to the space through which a heavy body moves in falling from a place in which it was at rest in the same time, and supposing a heavy body falls 15 foot in a second of time, by Calculation it will from thence follow, that the force of gravity has the same proportion to the centrifugal force at the æquator, that 289 has to unity; and therefore by this centrifugal force which arises from the Diurnal rotation of the Earth round its axis, any body placed in the æquator loses $\frac{1}{289}$ part of its gravity which it would have were the Earth at rest, or which is the same thing, a heavy body placed at either of the Poles (where there is no diurnal rotation, and consequently no centrifugal force,) which weighs 289 pounds if it were brought to the æquator will weigh only 288 pounds.

Having thus determined the proportion of the centrifugal force at the æquator to the force of gravity, it will be easy from thence to shew their proportions

tions in any parallel, for it is compounded of the proportion of 1 to 289, and of the co-sine of the Latitude to the Radius; for if two bodies describe different peripheries in the same time their centrifugal forces are proportional to their peripheries or to the semi-diameters of these Peripheries, as is determined by *Monf. Hugen* in his *Theoremata de vi centrifuga & motu circulari*: but the Periphery which a body in the æquator describes has its semi-diameter equal to the radius or semi-diameter of the Earth, and in any other place the parallels in which Bodies move have the co-sines of their Latitude for their semidiameters, and therefore it will follow that the force of gravity is to the centrifugal force in a proportion compounded of the radius to the co-sine of the Latitude and of 289 to 1. and therefore at the Latitude of 51 degrees, 46. minutes (for example) it will be as 466 to 1.

But we must observe that it does not from thence follow, that a body in that Latitude loses $\frac{1}{466}$ part of its absolute gravity which it would have were the Earth at rest; for that could not be, unless the centrifugal force acted di-

rectly contrary to the force of gravity, which is doth no where but at the equator, for in the Figure let the circle QPE represent the Earth Q E, the diameter of the equator O its Cent



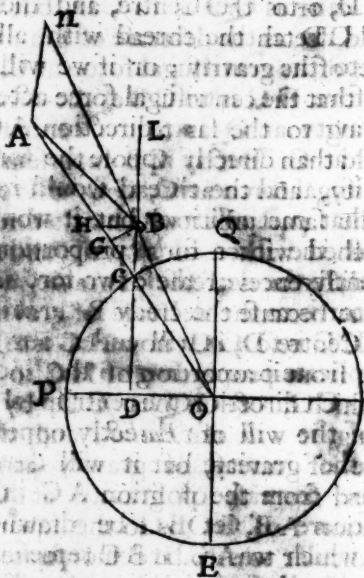
re, and let B represent a Body which we suppose to hang by the thread AB, and is placed any where between the Pole P and the equator Q, and let BD

be

be drawn perpendicular to the axis. It is plain that if the Earth had no diurnal rotation, the Body B would draw the thread A B into the position A C, since by that means it descends as near as it can to the Centre, and there it would stretch the thread with all the force of its gravity; or if we will suppose that the centrifugal force acted according to the same direction A C, it would than directly oppose the force of gravity, and the thread would remain in the same position, but it would be stretched with a force proportional to the differences of these two forces.

But because the Body B turns round the Centre D, it will endeavour to recede from it according to the line C B, in which direction the centrifugal force acting, it will not directly oppose the force of gravity, but it will draw the thread from the position A C into the position A B, let B G be drawn perpendicular to A C. If B C represent the centrifugal force acting according to the direction B C, it is equivalent, as is commonly known, to two forces one of which is as G C, and acts according to the direction G C, which is contrary to that by which it descends to O,
the

the other is as GB , and acts according to the direction GB , which is no way contrary to the force of gravity, If therefore BC represent the total

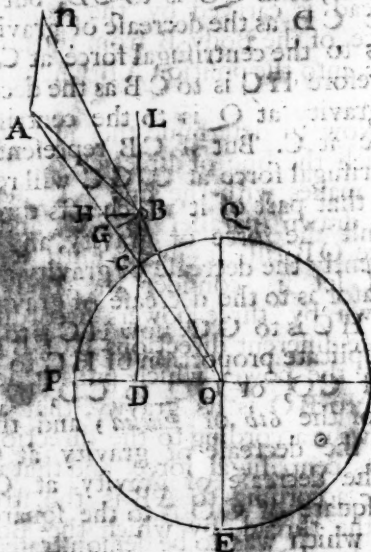


centrifugal force of the Body B, that part of it which directly opposes the force of gravity will be as GO : from whence it follows, that the decrease of gravity in going from the Pole to the Equator

Æquator is always as the square of the co-sine of the Latitude: for draw BH parallel to the Axis PP , and because the triangles HCB , CDO are æquiangular, therefore HC is to CB as CO is to CD , or as QO is to CD , but QO is to CD as the decrease of gravity at Q is to the centrifugal force at C , and therefore HC is to CB as the decrease of gravity at Q is to the centrifugal force at C . But if CB represent the centrifugal force at C , GC will represent that part of it which acts directly against the force of gravity, and consequently the decrease of gravity at the æquator is to the decrease of gravity at C as HC is to GC : now HC is to GC in duplicate proportion of HC to CB , or of CO , or OQ to CD , by the 8th of the 6th of *Euclid*; and therefore the decrease of gravity at Q is to the decrease of gravity at C , as the square of CO is to the square of CD which was to be demonstrated.

From whence it is plain that if HC represent the decrease of gravity at the æquator, and GC its decrease at C , then will GH represent the difference of these two diminutions, or the difference between the gravity at Q and the

the gravity at *C*, but *HC* is to *HG* in duplicate proportion of *HC* to *HB*, or of *OC* to *DO*, that is, the decrease of gravity at the equator is to its increase at *C*, as the square of the radi-



us is to the square of the sine of the Latitude.

By this also it will appear that the direction of heavy Bodies is not to the Centre of the Earth, as has been al-
ways

ways supposed. For if we take a heavy Body and hang it by a thread, the thread produced will not pass through the Centre any where but at the Poles and the Equator, for in the Figure the thread is carryed by the centrifugal force, of the Body B from the position A C, into the position A B where it will rest.

Now to determine the angle C A B which the line of direction of the Body makes with the line A C, let A N be drawn parallel to B C, and produce O B till it meet with it in N, and let us consider the Body B as drawn by three powers according to three different directions B O, B L and A B the power which pulls it according to B O is its gravity, that which draws it according to the direction B L is its centrifugal force, and that which acts according to A B is the strength of the thread, by which the Body is hindered to move according to either of the other two directions, and therefore it is in equilibrium with the other two powers, but by a Theorem which is demonstrated by several of the writers of Mechanics, but particularly by Monsieur Hugenot in his *Tractatus de viribus*

do not meet but at a great distance. From hence it follows that the force of gravity is to centrifugal force as AC is to BC : but a method has been already shown how the proportion of the force of gravity to the centrifugal force may be determined, and therefore the proportion of AC to BC , may be also determined, which at the Latitude of $51^{\circ} 46''$, is as 446 to 1. Therefore in the Triangle ABC , the proportion of AC to BC is known and the angle ACB being equal to the angle COQ which is subtended by the arch CQ the Latitude of the place, from thence by the Tables of Sines and Tangents the angle BAC may be known, which in the above mentioned Latitude is about five minutes.

From hence also it will appear that it is not the line AC , which being produced passes through the Centre, but the line AB that is perpendicular to the curve PQ , for all the particles of the fluid will settle themselves in such a position that their lines of direction downwards must be perpendicular to the surface of the Body which they compose, for otherwise the parts of the fluid

fluid would not be in an Equilibrium one with another, and therefore altho the lines of direction of heavy Bodies do not pass through the Centre of the Earth, yet are they still perpendicular to their Horizons, and upon this account there could arise no error in levelling of lines, and in finding the risings and fallings of the ground.

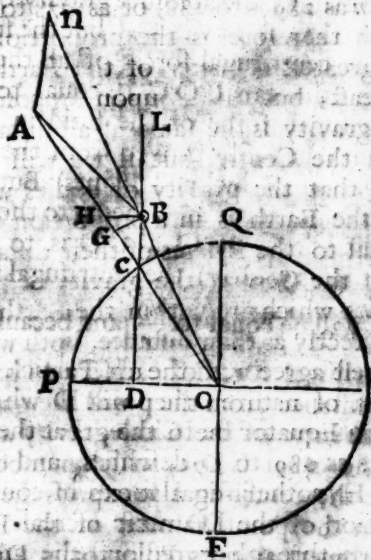
Upon this account also it will appear that the surface of the Earth is not spherical, for if it were, then would all lines drawn from the Centre be perpendicular to the surface of the Earth, since it is the known property of a sphere that they must be so, but I have already shewed that it is not so in the Earth, and therefore it is plain that the Earth is not a Sphere. That therefore I may enquire more particularly into the Figure of the Earth, I will resume my former hypothesis, that the Earth is composed of an infinite number of Canals which communicate with one another at the Centre and are all equipondentality of which we will consider two as OQ and OC , and let OQ be $= r$, $OD = a$ and $DC = y$, let the absolute gravity be called p , and the centrifugal force at the equator n , OC is

fugal force is $= \frac{1}{2}nr$, but upon the hypothesis, that gravity is the same at all distances from the Centre, the absolute gravity of the canal OQ is pr , and therefore its real weight upon the Centre OQ is $pr - \frac{1}{2}nr$. After the same manner the absolute gravity of the canal OC is $p \times \sqrt{x^2 + y^2}$ but the sum of the centrifugal forces of all the fluid in the canal OC is equal to the centrifugal force of the fluid in CD (as may be easily proved from the consideration of inclined Planes) But the centrifugal force at C being to the centrifugal force at Q as CD is to OQ (that is, as y is to r) the centrifugal force at C will be equal to $\frac{ny}{r}$ and because the centrifugal force of each Particle is as its distance from the point D which is the Centre of the Circle, that the fluid in the canal CD describes, and therefore the centrifugal forces in counting from the point D must increase in an Arithmetical progression, the greatest of which is $\frac{ny}{r}$ and therefore the sum of all the centrifugal forces in CD must be equal to $\frac{ny}{2r}$ therefore the weight

weight of the canal OC is $= p\sqrt{x^2 + y^2}$

$-\frac{1}{2}\frac{y}{x} = pr - \frac{1}{2}nr$ which equation ex-

presses the nature of the curve that is made by the section of the earth with



a plane through its poles, and by this the proportion of the axis of the earth to the diameter of the equator may be easily determined; for when CO coin-

note

cides with OP , then CD or y becomes equal to nothing, and the equation is $p\sqrt{x^2} = pr - \frac{1}{2}nr$ or $p\sqrt{x^2} = pr - \frac{1}{2}nr$, and therefore by the 16th of the 6th p has the same proportion to $p - \frac{1}{2}n$ that r has to x or OQ to OD , but p is to $p - \frac{1}{2}n$ as 289 is to 288 $\frac{1}{2}$ or as 578 to 577 which therefore is the proportion of the greatest diameter of the Earth to its least; but this is upon supposition that gravity is the same at all distances from the Centre, but if we will suppose that the gravity of bodies without the Earth is in a proportion reciprocal to the squares of their distances from the Centre, the gravity of those bodies which are within the Earth will be directly as their distance, both which do best agree with the observed Phenomena of nature; then will the gravity at the Equator be to the gravity at the Poles as 689 to 692, which numbers in this Hypothesis do also express the proportion of the Diameter of the Earth drawn through its Poles to its Diameter drawn in the plane of the Equator.

It is upon the account of this diminution of gravity, according as we approach the Equator, that pendulums of the same length in different Latitudes,

bodies, take different times, to perform their vibrations; for because the accelerating force of gravity is less at the Equator than under any parallel, and under any parallel it is still less than under another which is nearer the Poles, it do's plainly from thence follow that a body plac'd in the Equator, or in any parallel will take a longer time to descend through an arch of a given circle, than it would do at the Poles, and the farther a body is removed from the Poles, the longer time it will take to descend through any given space.

From hence it follows that the length of pendulums which perform their vibrations in equal times in different Latitudes are directly as the accelerating forces of their gravities. For the time a Body takes to descend through an Arch of a Cycloid, is to the time it will take to fall through the Axis of the Cycloid always in a given proportion, viz. as the Semiperiphery of a circle is to its Diameter by the 2nd Prop. of *Placius Horologium Oscillatorium*; and therefore when the times in which a body descends through the Axes of two different Cycloids are equal, the times of the descent through the Cycloids will be

also equal, but when the times of the descent through the Axes are equal these Axes, and consequently the lengths of the pendulum which vibrates in these Cycloids are proportional to the accelerating forces of their gravities.

By this, if we know the length of a pendulum which performs its vibrations in a given time, in any one part of the Earth it is easy to determine the length of a pendulum which performs its vibrations in the same time, in any other part of the Earth as for example: the length of a pendulum which vibrates seconds at Paris is three feet eight lines and a half, let it be required to find the length of a pendulum which vibrates seconds at the Equator. Because the gravity at the Pole is to the gravity at the Equator as 692 is to 589, therefore the decrease of gravity at the Equator is $\frac{1}{10}$ parts of the whole gravity: but as I have before demonstrated the decrease of gravity at the Equator is to its increase in any other Latitude, as the square of the radius is to the square of the sine of the Latitude: now the Latitude of Paris being $48^{\circ}45'$ its sine is 0.75 and therefore the square of the Radius is to the square of the sine of the Latitude

as

1

as

as 1000000 to 565248, but as 1000000 is to 565248, so is 3,000 the number which represents the decrease of gravity at the Equator to 1,695, the number which represents its increase at *Paris* which added to 689 the gravity at the Equator makes 690,695 the number which will represent the gravity at *Paris*. But I have already shewed, that as the gravity at *Paris* is to the gravity at the Equator, so is the length of a pendulum which vibrates seconds at *Paris* to the length of a pendulum which vibrates seconds at the Equator that is as 690,695 to 689, so is 36,708 the length of a pendulum at *Paris* which performs its vibration in a second to 36,516, which therefore is the length of a pendulum which performs its vibrations in a second at the Equator: so that the difference between these two pendulums is 192 parts of an inch which comes pretty near the observations of *Mons. Richet*, who at the island of *Cayen*, whose Latitude is 5 degrees, found that a pendulum which vibrates seconds there, was a tenth part of an inch shorter than a pendulum which vibrates seconds at *Paris*.

Thus we see that the principles and

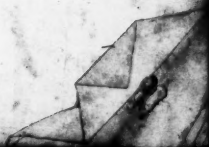
hypothesis and withal their consequences upon which the broad Spheroidical Figure of the Earth is founded do exactly agree with observations, and therefore there is no doubt to be made but that the Earth is really of such a Figure, and that the hypothesis upon which this Figure is grounded (viz. the diurnal rotation of the Earth and by consequence the centrifugal force of all Bodies upon it) must be admitted for a true one; since the different vibrations of Pendulums of the same length in different Latitudes can depend upon no other cause: for the change of Air is not able to produce any such effect, for if the Air made really any alterations in the vibrations of a Pendulum it would produce a quite contrary effect, than what is observed, for Pendulums near the Equator would move faster than they would do in places of greater Latitude; the Air in the one place being more rarified is much thinner and finer than it is in the other, and therefore gives less resistance to Bodies which move in it.

In this reasoning we have supposed the Earth to have been at first fluid as the Theorist has done before, but

but

but if we will put the case that the Earth was at first partly fluid and partly dry, as it is at present, yet because we find that the Land is very near of the same Figure with the Sea (only raised a little higher that it might not be overflowed) composing with it the same solid, and I have already shewed that the Surface of the Ocean is spheroidical and not spherical, there is no doubt to be made but that the Land was formed into the same Figure by its wise Creator, at the beginning of the World, for if it were otherwise, then would the Land towards the Equator have been overflowed with water, which as I have already proved, must have been higher at the Equator than at the Poles; and therefore the Sea would rise there and spread it self like an inundation upon all the Land.

But for a further confirmation of the spheroidical Figure of the Earth, let us consider some of the other Planets especially *Jupiter* who turns round his own Axis in the space of ten hours. It may easily be observed that his Axis is considerably shorter than the Diameter of his Equator, and that in the proportion of seven to eight, as the obser-



observations of Mr. Flamsteed and Monk
Casini do testify; and therefore we need
 not doubt but that the Earth which is
 a Planet like the rest and turns round its
 Axis as they do, is of the same Figure.

But the Theorist in his Latin Edi-
 tion of the Theory, as also in his An-
 swer to Mr. *Warren*, seems to insinuate,
 that the only way to find the true
 Figure of the Earth is by measuring
 of it, and by that means to find what
 proportion the degrees of the Meridian
 in different Latitudes have to one
 another; for if they were exactly equal
 one to another, and also equal to the
 degrees of Longitude counted upon
 the Equator, then without doubt the
 Figure of the Earth would be Spheri-
 cal, but is otherwise Spheroidical.

Now tho' I have already determin'd
 the Earths Figure from other Prin-
 ciples; Yet to comply with the Theo-
 rist in this point, I will give him an
 account of a Book whose extract I
 have seen in the *Acta Eruditorum Lipsiæ*
 publica for the year 1691. written by
 one *Joh. Casp. Esfenschmidt* a German who
 calls himself Doctor of Philosophy and
 Physick. The Title of this Book is
Diatribe de Figura Telluris Elliptico-Spher-
oide.

raide. And it is Printed at Strasburg in the Year 1691. The Learned and deep-thinking Author of this Book after he has Answered, at least has endeavoured to Answer the Arguments of *Archimides* and others, by which the Figure of the Earth was proved to be Spherical, doth embrace the Opinion of the Theorist, and asserts that its Poles are higher or further distant from the Centre than its Equator: To prove this, he sets down an account of the different magnitudes of degrees of the Meridian according to the observations made of them in different Latitudes, and comparing them one with another, he found that they continually decreased as the Latitudes increased, and indeed, as he says in the same proportion, as appears by the following Table, which I have inserted from the above named Extract.

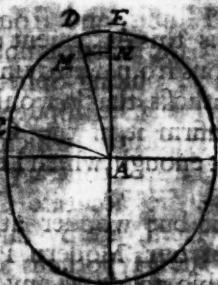
Observations	The Latitude of the Places observed	The Magnitude of a Degree in Radians
<i>Brussels</i>	50° 45'	100
<i>Ratislaus</i>	44°	80
<i>Mont. Picard</i>	49°	74
<i>Fernellus</i>	49°	73½
<i>Smolles</i>	52°	72½

From

From this he concludes that a plane cutting the Earth along its Axis would not be a Circle but an Ellipsis, whose longer Axis would pass through the Poles and coincide with the Axis of the Earth; but its lesser Axis would be the common Section of the Equator with the Ellipsis, and from thence he infers, that the Earth is not of a Spherical, but an oblong Spheroidical Figure. After that he disputes against Mr. Newtons Hypothesis, which makes the Earth of a direct contrary Figure, and thinks that the accurate Observations by him related, are by far to be preferred to the Hypothesis upon which Mr. Newtons Calculus is grounded.

None but a man of prodigious stupidity and carelessness could reason at this rate! If he had asserted that the Earth was of an Oval Figure because Grass grows or Houses stand upon it, it had been something excusable; for that Argument tho' it did not infer the conclusion, yet it could never have proved the contradictory to be true. But to bring an Argument which does evidently prove that the Earth has a Figure directly contrary to that which he would prove it has, is an intolerable

ble and an unpardonable blunder; for if he had but protracted the Figure, and drawn equal Angles from the Centre, he might have easily perceived, that the Angle whose Crura were longest, would have the greatest Subtense. Thus



if the Angles DAE and BAC were equal, but AD were longer than AB , it is evident that the subtense DE would be longer than the Subtense BC , for if you take AM and AN equal to AB and AC and draw the Line MN , the Angles being small, BC and DE will differ very little from straight Lines, but BC is equal to MN , which is plainly less than DE , and therefore it is evident that BC is less than DE , that is, where the Subtenses or the de-

grees

grees are greatest, there also is the greatest Diameter: but it is plain by the Observations which Mr. *Eisen Schmidt* relates, that the degrees are biggest at the *Æquator*, therefore the greatest Diameter of the Spheroid must be that of the *Æquator*, and not the Axis of the Earth.

So far is this Argument drawn from Observations from destroying Mr. *Newton's* Hypothesis, that it would most evidently confirm it, if the Observations were exact enough, which I believe they are not.

I cannot but wonder at the strange Logicks of our Modern Philosophers who are able to draw any conclusion they have a mind for, from any Principles that can be given them. No man that looks narrowly into their Books can want Instances in this matter, But in case this is not so well observed, I have furnished the Reader with two examples of this sort. The one is the Theorists way by which he proves the Earth to be of an Oblong or Oval Figure from the Principles of a Centrifugal force which all Bodies have that are on it. Now I think I have plainly shown that the true Conclusion he ought

ought to have inferred from this Hypothesis is, that the Earth had a quite contrary Figure from what he fancyed it had. But Mr. *Eisenchmidt* has given us a yet plainer proof of this thing, for because he found that the Degrees of Latitude near the æquator were bigger than those which were near the Pole, he very innocently concludes that the Earth had its Axis longer than the Diameter of its Equator; but if he had understood the first six Elements of *Euclid*, or indeed those of common sense he might easily have demonstrated the contrary: it is strange that when there is but one Right and one Wrong Opinion in this Point, that he should be so unlucky as to hit upon the false one to maintain it.

C 445

C H A P. VII.

*Of the Dissolution of the
Primitive Earth.*

HITHERTO I have refuted the Theorists for Motion, Position, and Figure, of the Primitive Earth. I am now to consider his method of Dissolving the Fabrick he has raised, and to Examin how and by what causes, the first Earth which had all the Beauty of Youth and Blooming Nature, Fresh and Fruitful, and not a Wrinkle or Scar on all its Body, came to be dissolved; how the Fabrick was broke, and the Frame of the whole torn in pieces, how it came to be a shattered and confused heap of Bodies, as we now see it, placed in no order one to another, nor with any correspondency or regularity of parts, as the Theorist represents it to be.

He tells us that one would soon imagine that such a structure as that of the first Earth was, would not be perpetual nor last many thousands of years, if
one

one consider the effect, the heat of the Sun would have upon it, and the Waters under it, drying and parching the one, and rarifying the other into vapours: For according to him, the course of the Sun was such at that time, that there was no diversity or alteration of Seasons in the year, as there is now; by reason of which alteration of Seasons, our Earth is kept in an equality of temper, the contrary Seasons balancing one another; so that what moisture the heat of the Summer sucks out of the Earth, is repaired again in Rains the next Winter, and what chaps are made in it are filled up, and the Earth is reduced to its former constitution. But if we should imagin a continual Summer the Earth would proceed in dryness still more and more, and the cracks would be wider and pierce deeper into the substance of it. The heat of the Sun therefore according to the Theorist, acting continually upon the Earth, would have reduced it in the space of some hundreds of years to a considerable degree of dryness, in certain parts, and would also have much rarified and exhaled the water under it; so that considering the structure of

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that

that Globe, the exterior Crust, and the Water under it he thinks it may be fitly compared to an *Æolipile* or an hollow Sphere, with Water in it, which the heat of the fire rarifies and turns into Vapour or Wind; the Sun here is the Fire, and the exterior Earth the shell of the *Æolipile*, and the *Abyfs* the water within it; as soon then as the heat of the Sun had reached the waters in the *Abyfs* it began to rarify them, and raise them into Vapours, by which rarification they required more room, than they did before, and finding themselves pent in by the exterior earth they pressed with violence against that Arch to make it yield and give way to their dilatation: and by this means the Earth was broken, and the frame of it torn in pieces as by an Earth-quake, and those great portions or fragments into which it was divided, fell down into the *Abyfs*, some in one posture and some in another, and was the cause of a general Deluge. I shall now examin these causes which the Theorist has given for the Dissolution of the Earth, and in this Chapter I will first enquire whither the heat of the Sun can reach so far as the

the

the great Abyſs to rarify the waters thereof.

First then I have proved in the third Chapter of this examination, that there were Hills and Mountains in the primitive Earth as there are now in ours. I have also ſhown that the Axis of the earth was then enclined the ſame way to the Plane of the Ecliptick as it is at preſent; from thence it plainly follows that there was then, the ſame variety of Seasons and Alternations of Heat and Cold in the primitive earth, that there are now in our earth, and by conſequence, all the Arguments drawn from the great heat and ſtrong action of the Sun upon the Antediluvian earth muſt fall to the ground, there being then no greater heat of the Sun on the earth than there is at preſent.

But *adly*, there are places in the earth, as the Iſland of *Barbadoes* and ſome other Iſlands near the Equator, where there is little or no variety of Seasons or alteration of the Suns heat, but it continues to ſhine very ſtrongly upon them throughout the whole year, and yet in none of them is there any of theſe great Chaps and Cracks which the Theoriſt ſayes were made in the

primitive earth by the strong action of the Sun; tho it has shon above thrice as long upon these Islands as it did upon the Antediluvian World:

sally, It is certain that if we judge according to experience that the heat of the Sun doth not reach far into the Earth, and that its beams can go but a very little way into the Crust; for in Vaults and Caves there is no sensible alteration of heat in Summer and Winter, even tho they have a communication with the open Air, And in the deep pits of the Royal Observatorie at *Paris* it has been found by experience, that a Thermometer placed there, in the coldest day of Winter does not sensibly vary from what it was in the greatest heat in Summer; and they who work in Mines can tell how little difference they observe of heat in the Summer, more than in the Winter, in places underground. But if the heat of the Sun could penetrate for any considerable depth the Crust of the Earth, it is plain, that when its heat is strongest and most intense upon the Surface, it would also be most intense within the Crust; but the forementioned experiments do prove that within the
bowels

bowels of the Earth there is no sensible difference between the heat of the Sun when its action is strongest from what it is when its action is weakest. Since then the heat of the Sun does not penetrate the Earth so as to be sensible even for the small space that we are able to dig thorough, how can we imagine it possible that it should ever reach the Abyss through the whole exterior Crust of the Earth so as to be able to heat the water and raise it into Vapour?

But that I may bring this point to a Calculation as near as I can, I will suppose that the heat caused by the direct influence of the Sun upon any Surface is alwayes (all other things being the same) as the quantity of Rayes of heat which falls upon that Surface; which I believe the Theorist will allow: I will also suppose that fewer Rayes of heat passed thorough the solid Orb than if it had been composed of several concentrical Surfaces placed at some distance from one another, every one of which transmitted only the one half of the Rayes of heat which fell upon it: this I think may be also easily allowed; for it is plain, that the Surface of the Earth does not transmit the half,

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may

may not the hundredth part of the Suns beams which fall upon it. These things being supposed, it is plain that but one half of the Rayes which fall upon the first Surface would fall upon the second, but one fourth of them upon the third, one eighth part of them upon the fourth, and one sixteenth part upon the fifth, &c. so that they would still decrease in a Geometrical proportion of 2 to 1; and if there were but one hundred of these Surfaces, the number of Rayes which fell upon the first would be to the number of Rayes which passed thorough to the last as 2^{100} to 1, or as the ninety ninth power of 2 is to 1. How great a disproportion then would there be between the number of those Rayes which fell upon the first surface and those which fell upon the last? for the ninety ninth power of 2 is a number which if written at length would consist of a hundred Figures; but if we should imagin all the spaces between the Surfaces filled up with solid and not diaphanous matter as it really is so in the Crust of the Earth, the heat upon the surface must be much less than what it would be by the former proportion.

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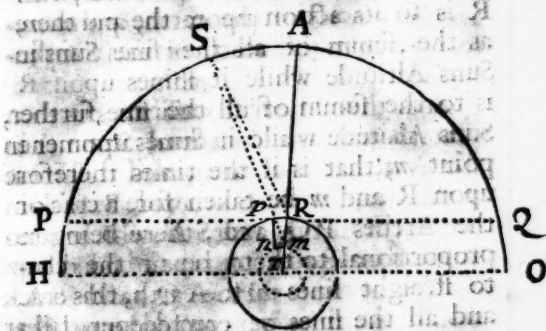
From thence we may conclude that if the heat of the Sun upon the Surface of the Antediluvian Earth was not much greater than it is now, it could never reach so far into the Crust as to be able to raise Vapours from the Abyss; or if it was so great as to be able to raise Vapours from thence, that is, if it was then as great upon the Surface of the Abyss as it is generally upon the Surface of the present Earth, it must have been almost infinitely greater upon the Surface of the Antediluvian World. Certainly there could be no necessity for a Deluge in that case, except it were to cool the Earth again after such an excessive heat, which must have destroyed all the Animals, Plants, and Trees which were upon the earth, and have turned them into Glass.

But perhaps it may be urged that the heat of the Sun does generate and prepare Metals which ly hid in its bowels; To which I answer, that I have already brought a sufficient demonstration that the heat of the Sun does pass but a very little way within the earth, and therefore the Opinion that Metals are generated by the Suns influence must be false;

for they generally lye far hid within the bowels of the earth, and therefore without the reach of the Suns influence,

But the Theorist affirms further, that there was a continual Summer in the Antediluvian earth, and therefore if the heat of the Sun made a crack in the earth in one year, there being no Winter or Rains to repair the chaps that were made in the earth, this crack would continually grow deeper, till at last it would reach to the Surface of the Abyſs. Let us now bring this general way of speaking to a Calculation, and try if the heat of the Sun could this way reach the Abyſs. To determin which, I will ſuppoſe that through length of time, the Sun has made a crack in the earth of a Miles depth and one hundred foot in length extended from *East to Weſt*, and let it be propoſed to Calculate what proportion the heat upon any point of the Surface bears to the heat upon the bottom of the crack. In the Figure let *P S A Q* represent the *Equator* in which the Sun moves, *P R T* the *Earth*, *P Q* the ſenſible *Horizon*, and *P a m R* the *Pit* made by the heat of the Sun

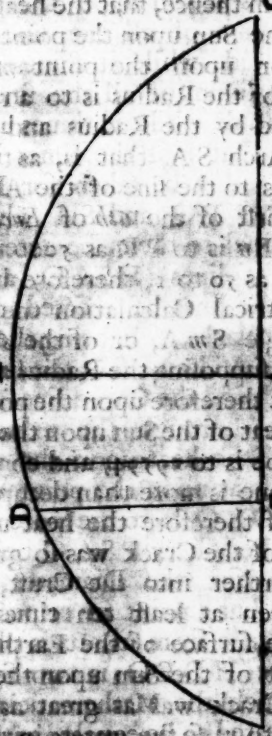
in



in the Crust of the Earth: it is plain that the Sun shines on the point R on the Surface of the Earth all the time it is moving through the Arch P Q, but it shines only on the point m in the bottom of the Crack while it describes by its motion the Arch SA. Now the Action of the Sun upon any point is alwayes more or less strong in proportion to the sine of the Angle of incidence of its Rayes, that is, if the Sun be at S, and afterwards come to A, the action of the Sun upon the point R when it is at S, is to its action when it comes to A, as the sine of the angle S R P is to the sine of the Angle A R P. From whence it follows, that the

the action of the Sun upon the point R is to its action upon the point m , as the sum of all the sines of the Sun's Altitude while it shines upon R is to the sum of all the sines of the Sun's Altitude while it shines upon the point m , that is if the times it shines upon R and m be taken for Basis's or the Arches P Q and S A which are proportional to them, be extended into straight lines H S A O, and S A, and all the sines be erected on them perpendicularly, A E being the Sine of the Arch A H and S D the sine of the Arch S H, and the Curve line H D E O be drawn thorough the extremity of the sines, the heat upon the point R is to the heat upon the point m , as the space H D E O is to the space S D E A, But the Periphery P S A Q being a semi-circle (for the Diameter of the Earth is but a point in respect of the Sun's distance from us) It is plain that the space H D E O is two figures of sines, which the Mathematicians have demonstrated to be equal to two squares of the Radius; and it is also by them demonstrated that the space S D E A is equal to a rectangle contained by the Radius and the sine of the Arch S A;
 but

HDEO is to the space D O A. The
 plain is therefore, that the heat on each
 on of the Sun upon the point R is to
 its action upon the point A as two
 squares of the Radius is to two other
 contained by the Radius and the line
 of the Arch SA. That is, as the square
 Radius is to the line of the Arch SA
 by the first of the rules of which the
 because it is a right angle, so the
 too, or as two to three, and a tri-
 gonometrical Calculation will shew
 the Angle SWA or of the Arch SA
 is a right angle. R is to the point
 the heat therefore upon the point R is
 to the heat of the Sun upon the point A
 as 20000 is to 22500 and therefore
 the heat upon the point R is to the
 other. It therefore the heat upon the
 bottom of the Creek was to grow as to
 reach further into the Creek, it must
 have been at least ten times greater
 upon the surface of the Earth, and it
 the heat of the Sun upon the bottom
 of the Creek, which is given near
 say it to be the greatest in the world
 into Vapours, and then they rise
 but as I have already shewed the heat
 of the Sun upon the point R is to its
 heat upon the point A as the space
 HDEO



H D E O is to the space D S A E. It is plain from thence, that the heat or action of the Sun upon the point R is to its action upon the point m as two squares of the Radius is to a rectangle contained by the Radius and the sine of the Arch S A, that is, as twice the Radius is to the sine of the Arch S A, by the first of the 6th of *Euclid*: But because P n is to P R as 5000 is to an 100, or as 50 to 1, therefore by a trigonometrical Calculation the sine of the Angle S m A, or of the Arch S A is 19594 supposing the Radius a 100000, the heat therefore upon the point R is to the heat of the Sun upon the point m , as 200000 is to 19594, and consequently the one is more than decuple of the other. If therefore the heat upon the bottom of the Crack was so great as to reach further into the Crust, it must have been at least ten times greater upon the surface of the Earth; and if the heat of the Sun upon the bottom of the Crack was as great as is necessary for to raise the waters in the Abyss into Vapours, or as great as our Summer heat is, the heat upon the surface of the Earth must have exceeded the heat of red hot Iron, which is only

seven

seven times greater than the ordinary heat of the Sun in Summer.

But notwithstanding all this, should I grant to the Theorist that the heat of the Sun had reached the Abyfs, and had raised the Vapours so that the crust of the Earth fell down and was broken in pieces, yet I cannot see how from thence there could follow any universal Deluge, or indeed any Deluge at all, tho the Theorist does endeavour to explain it thus.

When the Earth sayes he, was broken and fell into the Abyfs, a good part of it was covered with water by the mere depth of the Abyfs it fell into; and those parts of it that were higher than the Abyfs was deep, and consequently would stand above it in a calm water, were notwithstanding reached and overtopp'd by the waters during the agitation and violent commotion of the Abyfs; for it is not imaginable sayes he, what the commotion of the Abyfs would be upon this dissolution of the Earth, nor to what height its waves would be thrown when these prodigious fragments were tumbled down into it. If you would suppose a stone of ten thousand weight taken up into the Air, a
Mile

Mile or two, and then let fall into the middle of the Ocean, it is Credible that the dashing of the water upon that impressi^{on} would rise as high as a Mountain; but if you will suppose a mighty Rock, or a heap of Rocks to fall from that height, or a great Island or Continent, these would expel the waters out of their places with such a force and violence as would fling them above the highest Clouds.

This is in short, the method the Theorist has found out for making an universal Deluge. But if I can prove from his own Principles, that long before the Deluge happened, all the Waters in the Abyss were drawn up by the heat of the Sun to supply the Rivers that were necessary to water the Earth, I would fain know what would become of his Deluge, or how he can make in that case the fall of the Crust to be the cause of an Universal Flood: for by all the conception that I can have of it, the water which was upon the surface of the Earth, by the fall would rush into the Abyss; and it would be so far from making any Flood, that it would leave the surface of the Earth and make dry Land appear where formerly there
was

was none. To prove this I must first enquire what proportion the quantity of waters which the Sea receives from the Rivers of the Earth in any time bears to the quantity of water in the Ocean; and by consequence I will Calculate the time the Rivers would take to fill the Ocean if it were empty, and they ran as they do now, or which is the same thing, I will find what time the Sea would take to empty it self into the Rivers supposing that it was not recruited again by the continual course of fresh waters, which run into it, that is, if the Abyss did formerly supply all the Rivers with water, before the flood, and none of them ran into it again, as the Theorist supposes they did not, I am to find what time it would take to empty it self, on the surface of the Earth. And if I can prove that it would quite empty it self on the surface, long before the Deluge happened, I think from thence it would necessarily follow that there would be no Deluge at all, by the fall of the Crust.

To begin therefore, I will suppose as the Theorist has done, in his second Chap. Book first, that one half of the surface of the *Terraqueous* Globe is Sea, and

and the other Land, and that if we take the Sea one place with another, it is a quarter of a mile deep. Now the surface of the whole Earth being 170981012 *Italian* miles, the surface of the Sea is 85490506 square miles, which being multiplied by $\frac{1}{4}$ th (the Sea being $\frac{1}{4}$ th of a mile deep) the product is 21372626 $\frac{1}{2}$ Cubical miles, which is the quantity of water contained in the whole Ocean.

Now to Calculate the water the Ocean receives from the Rivers, we must consider some great river whose breadth depth and swiftness are best known, such is the *Po* which passes through *Lombardy* and waters a large Country of 380 miles in Length: *Ricciolus* in his *Geographia Reformata* tells us, that its breadth before its division into a great many Channels, by which it falls into the Sea, is a hundred *Benonian* Perches, or a thousand feet, and its depth is one Perch or ten Feet, and therefore its perpendicular Section, from one side to the other is a hundred square Peaches, or 40000 square Feet: Its swiftness also is so great, that the course of the water is about four *Italian* miles in an hour, or which is the same thing 2000

Italian

Italian Perches, for there are 500 Perches in a mile; The *Po* therefore carries into the *Adriatick* 200000 Cubical Perches of water, in the space of an hour, and therefore the quantity of water it brings into the Sea in a day is 4800000 Cubical Perches or 380000000 Cubical Feet of water; but one Cubical mile contains 125000000 Cubical Perches, and therefore if the *Po* takes one day, to bring into the *Adriatick* 4800000 Cubical Perches of water, it will require twenty six dayes, to carry into the Sea 125000000 Cubical Perches, or one Cubical mile, or which comes to the same thing, twenty six Rivers every one of which is of the same swiftness with the *Po* will pour into the Sea one Cubical mile of water in a day.

I must in the next place determin what proportion all the Rivers in the Earth bear to the *Po*, which to determin exactly would be a task, not easily to be performed; but I think we may determin it near enough for our present purpose, by supposing that the quantity of water received into the Sea by the great Rivers in any Country is very near proportional to the

extent and surface of that Country; And consequently the Country which is watered by the *Po*, and the Rivers which run into it, bears the same proportion to the surface of the whole dry Land, that the *Po* doth to all the Rivers in the Earth: But I have observed from the exactest Maps I could see, that the *Po* from its Origin in the *Alps*, to its end where it runs into the Sea, is in length three hundred and eighty miles, and that the Rivers which fall into it from each side, come from Springs of about sixty miles distance from the *Po*; consequently the *Po* and the Rivers which run into it, water a Country which is 380 miles long, and 120 broad, all which makes 45600 square miles; but the surface of all the Land being equal to half the *Terraqueous* Globe is 85490506 square miles, and therefore according to the proportion formerly mentioned, the water which is carried into the Sea by all the Rivers, is 1874 times greater than what the *Po* carries into the Sea.

It is true, there are in the Earth some barren places which have no great quantity of water or Rivers in them, but they being but small will not much

alter

alter our account, and for an Equivalent, we can easily prove, that tho there are some Countries not so well stored with Rivers as *Lombardy*, yet there are several others which are much better furnished with them, particularly the South part of *America*, where there are Rivers, which according to credible relations are above fourscore miles in breadth, and therefore by allowing a proportional depth, they will be several hundreds of times bigger than the *Po*.

Now I have already Calculated, that twenty six *Po's* will pour into the Sea one Cubical mile of water in a day; and consequently in 365 dayes, or in the space of a year they will pour into the Sea 365 Cubical miles of water: hence it follows, that if 26 Rivers as big as the *Po*, pour into the Sea 365 miles of water, in the space of a year, from 1874 Rivers as big as the *Po*, there will be brought into the Sea in the same time 26308 Cubical miles of water; and therefore by the rule of proportionals, in the space of 812 year, the Rivers will bring into the Sea 213726 Cubical miles of water, which is a quantity of water as great as the

Ocean: and therefore in that time they would fill the great Channel of the Ocean if it were empty, and their course the same, both for quantity of water, and swiftness that it is now: And since the Sea furnishes the Rivers with all the water that runs through them, it is plain that the Sea would empty itself in the space of 812 years if none of the Rivers ran into it again.

Since therefore according to the Theorist, the Abyss was the store-house which furnished the Rivers of the Antediluvian Earth with water, and none of them, according to him, ran into it again, and because all the waters which were antiently in the Abyss, are now in the Ocean, it must needs follow, that in the space of 812 years it would be quite empty, upon supposition that there were as many Rivers in the primitive Earth as there are now in ours; but because there was then twice as much Land to be furnished with Rivers (there being then no Seas as the Theorist sayes) we must in proportion allow twice as many Rivers to water the double quantity of dry Land, and therefore by such a double quantity of Rivers, the Abyss would be emptied in half that time.

Perhaps

Perhaps the Theorist will say, that the Rivers were not altogether furnished by Vapours drawn from the Abyſs, but by thoſe alſo that were exhaled from the ſurface of the Earth, and that after the water in the Rivers had run towards the Æquator and middle parts of the Earth, the water was again raiſed into Vapours by the great heat of the Sun, and carried back towards the Poles in order to ſupply the Rivers again. But this is no objection to our preſent Argument, for tho the Vapours drawn from the ſurface of the Earth, would no doubt encrease the quantity of water, in the Rivers, yet ſtill there would be drawn from the Abyſs, the ſame quantity of Vapour as was before; the ſame cauſe ſtill continuing to act, would ſtill produce the ſame effect, and the Abyſs having at firſt furniſhed the Rivers with a ſufficient quantity of water, would ſtill continue to do the ſame, and in the ſame quantity; and therefore it ſignifies nothing againſt the former Calculation, how much Vapour was drawn from the ſurface of the Earth, or how much the Rivers were encreaſed by it.

Since then I have ſufficiently proved

on the supposition of his Principles, that all the water, in the Abyfs was long before the time of the Deluge, drawn out of the Abyfs, and placed on the surface of the Earth; I would fain know how in that case the Theorist can explain an Universal Deluge by the fall of the outward Cruft of the Earth upon the Abyfs: for in my Opinion, this fall would have been so far from being the cause of a Deluge, that it would have proved the true way to deliver the Earth from a Deluge of waters which was then on it. For all the water which was in the Abyfs, being drawn up on the surface of the Land, and the Earth being of a Spheroidical and Oval shape, without Hills and Mountains, upper and lower Grounds, but exactly of the same Figure which its gravity and centrifugal force formed it into, when it was fluid; the great Mass of water which was then upon the Earth must have settled it self also in the same Figure, it having no banks to retain it within its Channel, or Mountains to keep it within bounds; and the true effect of the fall of the Cruft, must have been to have discovered the Land, and the waters would have run from

from the surface of the Earth into the Abyfs, and there would have formed a Sea, and made that Land appear which before was covered with waters.

Notwithstanding what I have already proved, I will now suppose, that all the water which is now in the Ocean, was in the Abyfs at the time of the Deluge, and that the Crust of the Earth was broken and crackt, and fell down on the surface of the Abyfs; yet still I cannot understand how this fall could produce an Universal Deluge, and make the waters swell above the tops of the highest Mountains. For the Theorist has Calculated, that it would at least require eight Oceans of water to cover the face of the whole Earth, and raise the waters to a height that would be requisite for drowning of the world. Now there being but one Ocean of water in the Abyfs, how is it possible that any however violent agitation and force by which the waters were driven upwards, should multiply this one Ocean of waters into eight Oceans? this I am sure is a thing as impossible for him to explain as it is for me to believe: it is plain indeed that the fall of the

Crust especially if there were any considerable distance between the Abyfs and it, would raise the waters to the tops of the highest Mountains, and would in some places produce a partial Deluge; but it is evident, that it is impossible in nature, let the motion be never so violent, that one Ocean should be sufficient to cover the whole Earth, and that above the tops of the highest Mountains, when eight Oceans are the least that can be required to perform such an effect. The waters indeed at different times, might have covered the whole Earth successively; first by making a Deluge in one place and then in another, but this could never have been brought to pass by the fall of the Crust at once. Besides the Scriptures inform us that the whole Earth was under water at the same time, & that *all the high Hills, that were under the whole Heaven, were covered*: now it is as impossible that one Ocean should suffice to drown the whole Earth, and cover the tops of the highest Hills, tho for the space of one moment, as it is to make one pint of pure water fill a vessel which holds a Gallon. This Argument which I have now used is the Theorists own, which
he

he has alledged in his *2d* and *3d* Chapters against all other wayes of destroying the Earth by a Deluge; but he did not then observe, that it concluded as strongly against his own Theory, as it did against any other which pretends to explain the Deluge without the supposition of more water than what was Lodged in the Ocean or the Clouds.

But tho I should suppose that there was sufficient water in the Abyss to cover the face of the whole Earth at once, yet I cannot conceive how such a flood of waters that was raised by the fall of the Crust, could last for so long a time, as the Scriptures inform us *Noah's* flood did, which was an hundred and fifty dayes without abating on the face of the Earth. We know that water driven with great violence upwards falls down again in a very short space of time; and can we Imagin that the water which was raised by the fall of the Crust, could last many dayes, or indeed many hours, without descending again to its ancient Channel? But the Scriptures assure us that the water in *Noah's* Flood continually encreased, and prevailed on the Earth for the space of one hundred and fifty dayes,

The Conclusion.

dayes; it is plain therefore, that for this very reason the Flood of *Noah* could never be produced by the fall of this outward Crust of the Earth.

The Conclusion.

THERE are two sort of Arguments that may be brought against the Theory, the one depends only on the principles of Reason and Philosophy, and the other on the Authority of the writings of *Moses*: but these which might be gathered from *Moses* would be of no force against the Theorist; * since he denies the truth of his narrations, which he imagines to be invented by that excellent Law-giver to please and amuse the Jews: I have therefore in this Treatise only made use of Arguments which are drawn from Philosophy, which he cannot refuse to admit since he appeals to them, for the Truth of his own Hypothesis.

Because the Theorist tells us, that all things were made according to the three Mathematical sciences of Arith-

* *Archæologie Philosoph.* p. 320, 321.

metick Staticks and Geometry, and that to understand the manner of their composition, we must proceed in the search of them by the same Principles, and resolve them into these again; I thought therefore I might fairly examin his Theory by the rules of those three Mathematical Sciences; and I hope that I have shown, that it is built on principles which are directly repugnant to each of them: But because Arguments drawn from the Mathematicks are not easily understood by those that are unacquainted with that Science, I have endeavoured to choose only those Arguments which are plain and obvious and which depend only on Arithmetick and the common principles of Hydrostaticks; so that except in one or two places, there is nothing in this Treatise but what may be easily understood by those who have a moderate knowledge in these Sciences.

The points I have examined according to these rules are, First The Origination of the Earth from a Chaos, which as it is delivered down to us by *Moses*, must be undoubtedly owned by those who acknowledge the Divine Inspiration of that Writer; But as the Theorists
method

method of forming the World is not agreeable to the *Mosaick History*; so I think I have shewed that it is repugnant also to the Laws of Nature and Gravitation, which by his method could never have produced any habitable World.

2dly, The form of the Antediluvian World, which the Theorist sayes, was smooth, regular, and uniform, without mountains and without a Sea. This he asserts to be a necessary consequence of its rise from a Chaos; but I have proved that it is not so necessary, that an Earth arising from a Chaos, should be uniform and smooth as he supposes. I have also shewed the great use of Mountains, and how necessary they are for our subsistence in the present Earth, and that they are so far from being placed here without design, as the Theorist imagins, that there is scarce any thing in nature that shews more of wisdom and contrivance than they do, being absolutely necessary for the furnishing and maintaining Rivers with fresh waters; which is a demonstration that they were in the primitive Earth as well as they are in ours.

3dly, The right position of the Earths Axis, which I have proved to be so far from

from being excellent and fitted for a Paradisiacal World, that it would make the greatest part of the Earth not habitable. I have also enquired into the great advantages we reap from the present position of the Earths Axis, which is by far preferable to any other, especially to the perpendicular position of the Axis of the Earth to the plane of the Ecliptick.

4thly, The method the Theorist has found out to form the Antediluvian Rivers when there was no Sea to furnish them with waters, or any Channel or Ocean to receive them. This I have proved to be impossible on several accounts since the heat of the Sun could never bring up so much Vapour from the Abyss, as would be necessary to furnish all the Rivers of the Earth with water; and tho we should grant that Vapours were drawn from the Abyss in places near the Equinoctial as he supposes, yet it is impossible that it should ever reach the Poles, there to form the Springs from which the Rivers were to run; Or if Vapours were once brought to the Poles by whatever cause we can imagin, yet it is impossible that they should ever run back
from

from the Poles to the *Æquator*; since according to him the Earth was perfectly smooth and uniform without any upper grounds from whence the water was to descend to the lower places of the Earth.

sibly, The Figure of the Earth which the Theorist rightly affirms not to have been exactly Spherical, because at the Commencement of the Diurnal rotation, it being Fluid all the parts of it would endeavour to recede from the Axis of their motion: but as he has guessed that it did settle into an Oblong Spheroidical or Oval Figure, on no other account, that I know of, but because he thinks such a one would best answer his design, so I think I have clearly enough demonstrated, that the Earth has formed it self into a quite contrary Figure, whose Axis is shorter than the Diameter of the *Æquator*; and I have proved from Observations, that the Earth is really of such a Figure.

6thly, The causes the Theorist has assigned for the breaking of the outward Crust which he affirms to be done by the great heat of the Sun. But this I have clearly proved to be a cause

cause altogether insufficient for such an effect, since the heat of the Sun could never reach so far into so thick a Crust as to be great enough to raise water into Vapours. But lastly, granting the Crust to have been broken, and to have fallen down into the Abyss, yet I have proved from the Theorists own Principles, that there could follow no Universal Deluge, there being not so much water in the Abyss as was sufficient to cover the face of the whole Earth.

Throughout the whole Examination, I have observed the Theorists advice, and have considered only the substance of the Theory without making any excursions upon things that are accidental and collateral, which as he sayes do not destroy his Hypothesis. These are the main foundations on which his Theory is built, and since I have proved them all to be not only precarious, but impossible, his whole Hypothesis must fall with them. Perhaps many of his Readers will be sorry to be undeceived, for as I believe, never any Book was fuller of Errors and Mistakes in Philosophy, so none ever abounded with more beautiful Scenes and surprising Images

SOME
REMARKS
ON

MR. WHISTON'S

Theory of the Earth.

THO I think it impossible to give a True and Mechanical account, of the great Deluge of waters which once overflowed the Face of the whole Earth, it being a work not to be performed without the extraordinary contrivance of the Divine power; yet I cannot but acknowledge that Mr. *Whiston* the Ingenious Author of this new *Theory of the Earth*, has made greater discoveries, and proceeded on more Philosophical Principles than all the Theorists before him have done. In his Theory there are some very strange coincidents which make it indeed probable, that a Comet at the

M time

time of the Deluge passed by the Earth. It is surprizing to observe the exact correspondence between the *Lunar* and *Solar* year, upon the supposition of a circular Orbit, in which the Earth moved before the Deluge. It cannot but raise admiration in us, when we consider, that the Earth at the time of the Deluge was in its *Perihelion*, which would be the necessary effect of a Comet that passed by at that time, in drawing it from a Circular to an Elliptical Orbit. This together with the consideration that the Moon was exactly in such a place of its Orbit at that time, as equally attracted with the Earth, when the Comet passed by, seems to be a very convincing Argument that a Comet really came very near, and passed by the Earth, on the day the Deluge began.

But notwithstanding this, I believe it will be evident by the following considerations, that a Comet could never have produced those various effects that Mr. *Whiston* has attributed to it; and it will also further appear that the Deluge was the immediate work of the Divine power, and that no secondary causes without the interposition of Omnipotence,

nipotence could have brought such an effect to pass. But first I will make some Remarks on the Origin of the Primitive Earth, and method by which Mr. *Whiston* supposes it was formed.

Mr. *Whiston's* first Hypothesis is, that the antient Chaos, the Origin of our Earth was the Atmosphere of a Comet; but this supposition, tho' he endeavours to prove it by several Arguments, doth not seem probable for the reasons following. First the Scriptures represent the Primitive Antient Chaos as a very dark and obscure Body, for they say, that it was *without form, and Void, and that Darkness was upon the face of the Deep*: this will farther appear by the next verse, where God is said to have made light upon the first day of the Creation, which is a clear proof that there was none before that time, and that the whole Chaos was originally a dark and confused heap of Bodies. Now it is certain, by the Testimonies of all those who have made any Observations about Comets, that their Atmospheres are very bright and luminous Fluids through which the beams of the Sun diffuse themselves very freely, and many of them are again reflected back to

us: and indeed, if we consider their pellucidness, and the vast quantity of Light which passes through them, without reflection, it is not easy to imagine how they should appear so lucid to our Eyes. Nor do I believe that it is possible to find among all the pellucid Bodies of our Earth any one, which being placed at the same distance from us, as the Atmosphere of Comets are, would appear so bright, or reflect the light so strongly as they do. For it is easy to be observed, that diaphanous Bodies are not so luminous, nor do they reflect light in such a quantity as it is reflected from opaque Bodies. It cannot be said that the light by which we perceive a Comet, is only reflected from the top of its Atmosphere, and that it doth not pass through the Body of it to illuminate all the other parts of it, which are therefore involved in thick darkness; for it is evident that light passes clearly through the whole Body of the Atmosphere, and illuminates the central solid, which strongly reflects the light to us back again.

I know Mr. *Whiston* supposes, that this great darkness mentioned in the Scripture, proceeded from the subsiding

of the vast Dense and heavy Fluid, or large Abyfs, which he faves encompassed the central solid, and was it self covered over with a collection of Earthly, Watery, and Airy particles, intercepting and reflecting all the Rays of light which fell upon it: but this I think doth not well agree with the tenour of Scripture, which represents the Chaos in its very Original state, as involved, with darkness and obscurity. It is also repugnant to all the ancient Traditions we have about it, which represent it as a dark and confused heap of Bodies, from the very beginning of its existence, till the time of the Creation or Formation of the Earth. It is plain also that the Abyfs or Deep mentioned in Scripture, could not be that dense and heavy fluid Mr. *Whiston* speaks of, on which he faves the upper Crust of our Earth is founded; it being certain, that the Scriptures are to be understood of an Abyfs which was then dark, and afterwards when light was Created, was illuminated and made visible. For when light is said to have been made, without doubt we must suppose, that it was produced in some place which before was involved in

M 3 darkness,

darkness, and then exposed to the light, which can never agree with Mr. *Whiston's* Abyss, which he makes to be encompassed with a dense and opaque Crust perfectly impenetrable by the light of the Sun. It appears therefore, that this darkness mentioned in the Scriptures must be understood to be somewhere else than on the Surface of a dense and heavy fluid that surrounds the central solid.

It is also to be observed, that it is not easy to conceive how these Earthy, Watery, and Airy particles, should fall so thick and fast on one another, as would be sufficient to intercept all the light which fell upon them, and quite darken the Atmosphere, without suffering the least glimmering of light to pass through them. For as Mr. *Whiston* observes, the heat of a Comet when it passes its Perihelion is so excessively great, as to last many thousand years; and we cannot doubt but that great commotion and confusion which is raised by this heat must last proportionally, and as the heat doth gradually decrease, so must the commotion in the Atmosphere decrease proportionally: by which the most solid

lid and heavy Bodies would soonest fall down. And one would think that it would not be the work of one or two years, but it would require some thousands of years after the solid Bodies first began to fall before the Atmosphere, could settle it self into a regular and uniform Body. And therefore since all these diaphanous and solid Bodies which composed the outward Crust fell so slowly and by degrees on the Abyss, and since at the time they were all there, they were not able to darken the Atmosphere; I think that by their slow and gradual descent, they would not fall so thick upon one another, but that the Comets Atmosphere would still be penetrated and illuminated by the light of the Sun.

But if I should grant to Mr. *Whiston*, that there were such dark and thick Clouds in the Atmosphere of the Comet as were sufficient to intercept all the light that should be derived to it from the Sun; yet if we consider that the central solid of a Comet, is a Body which by reason of its near approach to the Sun, is scorched and burned by very intense heat, and that all solid and hard bodies when they

are heated to any considerable degree are clear and luminous; we must acknowledge that the proper and native light of Comets, if I may so call it, is very considerable; and therefore upon this single account of a Comets proper light, it cannot be such a dark and obscure Body as that Chaos was from which the world had its Origination.

Since then the Atmospheres of Comets are clear and pellucid luminous Bodies, through which we can distinctly view their central solids; and since the Chaos out of which the world was made from its very Original, was a dark and confused heap of Bodies without the least glimmerings of light, which^o was not created till the first day of the Hexaëmeron; it is plain that this Chaos could never be the Atmosphere of a Comet, and therefore Mr. Whiston's first Hypothesis is but ill grounded.

It is also to be observed, that the greatest part of these solids, which compose our upper Stratum, consist of Stones, Sand, and Gravel; and that they when they are once heated to any considerable degree, are necessarily melted
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and turned into Glas. Now if they had ever existed in the Atmosphere of a Comet, when it was near the Sun, they must have sustained a degree of heat some hundreds of times greater than the heat of red hot Iron; and consequently they must have been melted: and during the time of their immense heat they would have composed a fluid, which afterwards when the Comet was cooled, would appear in the form of Glas; by which it is plain, that those Bodies never were in the Atmosphere of a Comet, for otherwise they could never have appeared to us in the form they are in at present.

Mr. *Whiston* asserts, that there are very many, and very considerable Phænomena of nature, which require a central force, or internal heat, diffusing warm steams every way from the centre to the circumference; and especially he seems to be pleased with Dr. *Woodwards* method of raising Vapours through the Earth to furnish the Rivers with water by the help of a central fire; which he thinks is easily accounted for, by supposing the interior solid of the Earth to have been the *Nucleus* of a Comet, that once in its approach

proach to the Sun had acquired an immense heat, which it doth still in a great measure preserve: but this Opinion, tho it has been maintained by a great many Learned Men, seems to be very improbable. For if I should suppose that there was such a central fire, yet it is not to be imagined, that it could ever diffuse it self, and penetrate the exterior parts of the Earth. We know by experience, that if a stone wall of four or five foot thickness be heated red hot upon one side, that the other continues as cold as before, without being sensibly affected with the heat which is intense on the opposite side. Since then we see that an intense heat is not able to penetrate through a stone wall, how can we suppose, that it should diffuse it self through a dense and heavy fluid, an hard and diaphanous Crust of some hundreds of miles thickness?

x I know none of the Phænomena of nature that do necessarily require a central fire. For as to burning Mountains and Volcano's, if Mr. *Whiston* will be pleased to consult *Borelli de incendiis Montis Aetnae*, he will easily be convinced, that its fire doth not proceed from the Centre, but that it is kindled very near the

the surface of the Mountain. And as for Rivers, I believe it is evident, that they are furnished by a superior circulation of Vapours drawn from the Sea by the heat of the Sun, which by Calculation are abundantly sufficient for such a supply. For it is certain that nature never provides two distinct wayes to produce the same effect, when one will serve. But the increase and decrease of Rivers, according to wet and dry Seasons of the year, do sufficiently shew their Origination from a Superior circulation of Rains and Vapours. For if they were furnished by Vapours exhaled from the Abyss through subterraneous Pipes and Channels, I see no reason why this subterraneous fire, which alwayes acts equally, should not alwayes equally produce the same effect in dry weather that it does in wet. Besides this, since the Mountainous Columns are erected not on the Surface of the water, but stand immediately on that dense and heavy fluid which covers the central solid; I cannot easily conceive how water should ever come to the bottom of the Fissures to be raised into Vapours. Nor can I well conceive that prodigious heat,
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that must be sufficient to raise as much Vapour through some small Fissures in Mountains as the heat of the Sun is able to do from the whole Surface of the Sea.

I know the maintainers of this Opinion use to alledge, that there are Springs and Fountains on the tops of Mountains, which cannot easily be maintained by a Superior circulation of Vapours : but I beg those Gentlemen pardon, for I can give no credit to any such Observations ; for I am well assured, that there are none of those Springs in some places where it is said they are. And particularly that Learned and diligent Observer of Nature Mr. *Edward Lloyd* the Keeper of the *Museum AsbmoLEANUM* assured me, that throughout all his Travels over *Wales*, he could observe no such thing as a running Spring on the top of a Mountain. On these considerations, I think it is not in the least probable, that Rivers and Springs proceed from Vapour, that is, raised by a subterraneous heat through the Fissures of the Mountains.

I come now to consider the way Mr. *Whiston* makes use of, to explain the formation of the Sun, Moon and Stars,
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by which he says in the *Mosaical* account of the Creation, no other thing is understood than the rendering of them visible and conspicuous to a Spectator on the face of the Earth: for before the fourth day according to him, the Air was much crowded with thick and opaque Clouds, which would very much darken the face of the Earth, and keep a Spectator on it from being able to perceive either Sun, Moon or Stars, which were created long before that time. In this place I think Mr. *Whiston* has not exactly observed his first *Postulatum*, viz. that the obvious and literal sense of Scripture is the true and real one, where no evident reason can be given to the contrary. For since the formation of the Sun and Stars at that time was possible, and the Scriptures positively tell us, that they were made by God Almighty at that time; I think there can be no evident reason given which will be sufficient to justify such a forced and strained sense as he has here put on the words of Scripture.

But tho I should suppose that the literal sense of Scripture did not in the least contradict such an exposition, yet it appears to be impossible on his Hypothesis

pothesis for these reasons. First, I have already proved that the Atmosphere of a Comet is a very clear and pellucid Body that doth freely admit both the light and heat of the Sun through it; and consequently there is no doubt to be made, but that an Eye placed within would have the Sun very visible and conspicuous to it. It is evident therefore, granting this Hypothesis of the Earths being formed from the Atmosphere of a Comet, that the *Mosaic* account of the formation of the Sun and Stars can never be understood of rendering them visible; since according to such an Hypothesis they must have been always so.

adly, Whatever Mr. *Whiston* may imagine of the Sun, yet it is certain that the Moon at the time of the *Mosaic* Creation was formed or at least placed in its orbit, and made to turn round the Earth; for no Comets have any secondary Planets which move round them: since then the Moon did not before that time appertain to the Earth but was really at the time of the *Mosaic* Creation, if not Created and formed, at least brought into a new orbit, and made to move about us to give

us Light in the night time; we must necessarily acknowledge, that when God is said to have made the Moon, there must be something more understood than a mere rendering of it visible; and because the word *Made*, is equally applied in Scriptures both to the Sun and Moon; there is no doubt but that it is to be understood in the same sense of both, that is in a literal one, *viz.* That they were really Created, when in Scripture they are said to be made on the fourth day of the *Mosaick* Creation.

3dly, Mr. *Whiston* supposes that the Sun acted so very strongly the second day of the Creation on the Earth, that it was able to draw a prodigious quantity of Vapours into the Air, such as were sufficient enough when they fell in Rain, to produce all the Seas, Lakes and Rivers that were in the Primitive Earth: but how the Sun could have such an extraordinary influence on the Earth without being visible, is a question which I believe cannot be easily answered; for there is a great difference between the heat of the Sun when it shines bright and clear, and its influence when it is obscured with Clouds
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and Vapours; Indeed one would think that it would require a prodigious heat, to elevate such a quantity of Vapours in one half year as would fill all the Channels of the Seas and Lakes with water. I am sure that the Sun now when it is brightest is not able to perform any such effect; for if we should collect all the Rain that falls in the space of a year on the surface of the Earth, it would not rise on the whole surface of the Earth, above a foot and a half high; which is not enough to make the thousandth part of an Ocean. Since then according to Mr. *Whiston*, the Sun was capable on the second day, to perform an effect some hundreds of times greater than its heat when it shines clearest and brightest is able to do on our Earth, I think we may undoubtedly conclude that it must have been visible even at that time; that is, it must have been visible before it was said to have been made, which cannot be imagined in whatever sense we take the word *made*.

Indeed I cannot but think it strange, that Mr. *Whiston* should suppose, that there was some hundreds of times more
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water drawn by the heat of the Sun in one half year, than there is now exhaled from our Earth in double that time: since he himself acknowledges, that we do every day enjoy more of its Heat and Light than the Primitive Earth could be supposed to have done for a considerable space of time: this I confess seems to me, to be a very wonderful and unaccountable effect, and not at all proportional to its cause; but if he will suppose that it was really so, I need not argue much against it, since I am sure, such a supposition must necessarily allow the Sun to have been at that time visible.

Mr. *Whiston's* third Hypothesis is, that the diurnal rotation of the Earth, did not commence till after the fall; so that till that time, Days and Years were exactly equal and the same: the Earth having no other motion but its annual one round the Sun, all the World would have for one half of the year a continual Day, and for the other a continual Night. Here I must freely own my self to be one of those Readers to whom Mr. *Whiston* says this assertion will appear one of the greatest of Paradoxes: for when I consider

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the vast and prodigious cold that must be occasioned on the Earth, by the total absence of the Sun for one half year together, I think that it would be so excessively great, as that 'twould have been impossible to be endured by Creatures made of Flesh and Blood. We are extremely sensible of the great cold we sustain by having our Night in the Winter sixteen hours long, but yet it is nothing to what it would be, were the Sun for half a year together absent from us: how cold and uncomfortable a darkness must that have been in which our first Parents passed the one half of their Paradisaical life, when in the other half they must have been scorched and roasted with the immense heat of the Sun, which shined on them continually for as long a time, as they were before in the dark. This heat in my opinion, would have quite withered the Herbs and Plants which were then designed to be the food of Mankind; it would have forced our first Parents to seek for shelter in Dens and Caves, which would have been, in such a state, more convenient than the Garden of *Eden*; and it would have been altogether as unsupportable as the former cold.

cold. It is evident that such a state would be so far from being agreeable with that happy and pleasant Paradisiacal life which our first Parents are said to have lead in their state of Innocency, that the *Legend-makers* and *Poets*, thought it a fitter representation of Hell and its Torments, than of that state of happiness; some of them having feign'd that there were Ghosts brought from Hell on purpose to inform us that a great part of the miseries of the damn'd consisted in their being driven from extreme hot places to extreme cold ones.

There is one very convincing Argument against this supposition arising from the consideration of the nature of Animals, whose Blood and other liquors that run in their Bodies are not able to endure two such opposites as the extream heat caused by the Sun while it shined for one half year without intermission on the same place; and the extreme cold that must arise through his absence for the same time. For if we should suppose that these animal liquors were of such a constitution and internal heat as not to be frozen by an extreme cold, yet it is certain that they must evaporate and be

exhaled by the extreme heat that came after it in the day time: or if they were able to sustain such an extreme heat without evaporation; then without doubt they could not preserve themselves from freezing in an extreme cold which they must have suffered in such a Winter or half a years night.

I know there are Animals which live near the fire, and are able to endure an extraordinary heat; as there are others that live near the Pole and in very cold Climates: but it is not imaginable there can be any such that can live both in excessive heat and excessive cold; it being impossible that ever they can endure two such opposite extremes. Tho this seems to be a very pressing difficulty against such an Hypothesis, yet there is another that I think as insolvable, arising from the consideration of the nature of Plants.

We know that there is a certain determinate degree of heat necessary for the production and vegetation of most Herbs, and for the ripening of their Seed; so that a less degree of heat would never bring the Plant to perfection, and a greater would quite wither it before its Seed could be ripened and fit

fit for the production of a new Plant of the same species. It is easily observable, how great difficulty there is, and how much pains must be taken, by hot beds, and other artificial helps to raise Plants in this Climate, which are transplanted hither from the *Torrid Zone*: but this difficulty proceeds no doubt, from the want of such a due influence of the Sun as was necessary for the production of these Plants; so that by reason of the great difference between the heat which they had in their own proper Soil, and that which they participate of here, it is hard to bring them to perfection: but if we should suppose this alteration to be some hundred of times greater than it is, without doubt we should conclude it impossible for any such Plants to grow with so little a degree of heat. But this must have been the true case of the Plants in the Primitive Earth: At first before the diurnal rotation of the Earth began, they sustained a degree of heat some hundreds of times greater, than the greatest heat we have in Summer; but after the Earth began to turn round its Axis, the heat and action of the Sun on them came to be of the same force and te-

nour that it is of at present ; but I have observed before, that all plants and Herbs require a certain determinate degree of heat and influence from the Sun ; and as a much greater heat will wither them, so less will never bring them to perfection : on which account it seems to be naturally impossible, that ever any of these Plants, whose nature and constitution was fitted for the heat of the Sun, before the commencement of the Earths diurnal rotation, could ever be brought to perfection after it began to turn round its Axis in the space of twenty four hours, by which the action of the Sun would be very much less than before. If therefore the Earth had no diurnal rotation till after the fall ; and if then only it began to turn round its own Axis, there must have been such great and extraordinary changes and alterations of heat and cold introduced by this new rotation as would necessarily require new Species of Plants and Vegetables of different natures from the former ones, which would better agree with the new rotation and constitution of the Earth, and the action of the Sun. That is, God Almighty must have created new and different

different sets of Plants, or at least have quite altered and changed the natures of the old ones, which we can hardly imagin to be done.

It is on the account of these reasons that I cannot be induced to believe Mr. *Whiston's* Hypothesis, that the Earth had no diurnal rotation before the fall, to be probable; it seeming to be far more agreeable to the Laws of Nature and Philosophy, that the Earth received both its annual and diurnal motions at the same time, *viz.* when it was first Created.

These are the chief and principle Remarks that I have made on the Original State and Formation of the Earth; I will now briefly consider his Theory of the Deluge which is in short thus.

He supposes that a Comet at the time of the Deluge came very near and passed by the Earth; that the Comet, when it came below the Moon, would raise a vast and strong Tide, both in the Seas that were then on the Surface, and in the Abyss, which was under the upper Crust of the Earth, after the same manner as the Moon doth at present in the Ocean; that this Tide would begin to rise and encrease all

the time of the approach of the Comet; & would be at its greatest height, when the Comet was at its least distance from the earth. By this tide and the attraction of the Comet, he supposes that the Abyſs would put on an Elliptick or rather an exactly oval figure; whose surface being much larger than the former ſpherical one, the exterior cruſt of earth, which lay upon it, muſt conform it ſelf to the ſame figure, which it could not do as long as it remain'd ſolid and conjoin'd; and therefore it muſt of neceſſity by the violent force of the tide be ſtretched and broken, and have innumerable ſiſſures made quite through it. After this he ſuppoſes that the Comet in its deſcent towards the ſun paſſing cloſe by the body of the earth involved it in its Atmosphere and tail for a conſiderable time, and left prodigious quantities of condensed and expanded vapours on its ſurface, a great part of which being very much rarify'd after their primary fall, would be immediately drawn up into the Air again, and afterwards deſcend in violent and outrageous Rains upon the Earth; and would be the cauſe of the forty dayes rain mentioned in Scripture. The other
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great Rain, which together with the former, lasted an hundred and fifty dayes, was occasioned as he thinks, by the Earths being involved a second time in the Comets tail; from which, and from its Atmosphere he derives one half of the water, which served for the Deluge. The other half he supposes was deduced from the subterraneous Abyss, the fluid whereof he says was forced upon the Surface of the Earth, by the vast and prodigious pressure of the incumbent water that was derived from the Comets Atmosphere and Tail, which he supposes, would press downwards with a mighty force, and endeavour to sink the outward Crust of the Earth into the Abyss: by which vast quantities of the subterraneous fluid, would be forced and raised upon the Surface of the Earth, through the Cracks and Fissures, that were made in the Crust by the violence of the Tide in the Abyss. By these methods Mr. *Whiston* supposes that there was water enough brought on the Surface to cover the face of the whole Earth for the perpendicular height of three miles, that is, above the tops of the highest Mountains. But he further supposes, that
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neither that water which was derived from the Comet, nor that which was forced up from the bowels of the Earth, was pure Elementary water, but rather a thick and muddy fluid, which he says being heavier than water, sunk to the bottom and covered the Earth, for the depth of 166 feet. After having thus formed the Deluge, his next great work is to remove these waters which were brought on the Earth; and this he supposes to be performed by a wind, which dried up some, and forced the rest through the Cracks and Fissures of the Earth into the Abyss, in which a great part of them had been before, and from whence they were derived.

These are the suppositions by which Mr. *Whiston* pretends to account for all the Phænomena of the Deluge. But tho I can easily allow the first Hypothesis to be true, viz. That a Comet at the time of the Deluge came very near and passed by the Earth, since its approach at that time is not only made possible but also very probable by him; yet I cannot admit of the particular explications he has given of several of the Phænomena of the Deluge; a great many of them, as he has explained them,

them, seeming to be no wayes agreeable to the Laws of Mechanicks and Philosophy.

For first, tho it is certain, that a Comet, when it passed by the Earth, would raise a very strong and prodigious Tide in the Seas that were then on the Surface; yet I cannot perceive, that such an effect would be produced in the Abyss, which he supposes to be a dense and heavy fluid encompassed on all sides with a thick and solid Crust of Earth lying closely upon it. For Tides being only a violent swelling and motion of the waters produced by the attraction of some great Bodies that come near them, if we should suppose that the waters were every where shut up within a solid Orb lying on them, so that there were no room or space left for them to move in, it is plain that in such a case there could be no Tide or agitation of the waters, but they would remain in the state they were in before; nor could they press stronger on that Orb which inclosed them, than Sand, Gravel, or any other firm and hard Bodies would do, that could fill their place; all Bodies whether firm or Fluid, being equally attracted

tracted, when the attracting Body is at the same distance from them. This being then the true case of the Abyfs, which Mr. *Whiston* supposes to be enclosed by the thick solid and upper Crust of the Earth, which pressing so close upon it as to leave no void space, at least not such a one as would make room enough for any considerable commotion of the waters; and because fluids are not more attracted than solids are; it is plain that by the Tide of the Abyfs, and the attraction of the Comet, there could never be produced any greater effect on the Crust, which encompassed the subterraneous fluid, than if the whole Earth had consisted of firm and solid matter, without any Abyfs. It is certain therefore, that since there was no tide in the Abyfs, there could be no cracks and fissures made in the Earth by it.

To explain the great rains, which fell on the Earth during the time of the deluge, Mr. *Whiston* assumes a proposition which I believe he can hardly prove, viz. that after the Earth was involved in the Comet's Atmosphere and tail, and had acquired a prodigious quantity of

of condensed and expanded Vapours that fell on its surface, a great part of them being much rarify'd, would be drawn up again into the Air, and afterwards descend in violent and outrageous rains. Now if we consider the incredible velocity, with which these Vapours descended (which Mr. *Whiston* calculates to be so great, that they descended eight hundred and sixty eight miles in a minute) and the great resistance they met with in their descent through the Air, and the force by which they fell on the ground; we must necessarily acknowledge, that they must have been condensed and turned into Water, by such a resistance and fall. For it is certain, that when Vapours fall, they must meet with a great check and resistance from the Air, by which their parts will be pressed close together; and as their velocity encreases, so would the resistance and their density till at last their parts come to be as closely united as it is possible, and then they'd fall in the form of Water. Thus it is without doubt, when it rains; for we must not imagine, that rain drops have the same form and density in the Clouds

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with which they arrive at the ground; for Water being of a greater intensive gravity than Air, it is impossible, that it should be sustained in it, but when it is expanded into Vapour. Now it is plain by observations on the Barescope, that, whenever the Vapours begin to descend, the Air is lighter than it was before; it therefore not being able to sustain them, they must fall to the ground; but in their way they meet with a great resistance, and check from the Air, and so must necessarily be condensed and fall in drops of Water on the ground. And since the resistance of the *medium* is always as the square of the velocity with which the Body moves through it, and because the velocity of vapour which fell from the Comet to the Earth, must have been according to Mr. *Whiston*, some thousands of times greater than the velocity with which common Vapour or Rain descends, it must needs follow, that the resistance the Vapour, which was derived from the Comet, met with, was some millions of times greater than the resistance of common Vapour when it descends; but the resistance of common Vapour, when it descends, is great enough to condense it

it into water; it is evident therefore, that all such Vapours as descended from the Comet must have been of necessity condensed into water long before they ever touched the Earth. Seeing then they descended on the Earth in the form of water, and seeing there was no sufficient cause that could immediatly raise and mount them up again, the heat of the Sun not being great enough for such an effect; it is plain, that they could never rise up again to produce the forty Dayes Rain mentioned in Scripture.

Mr. *Whiston* having, as he imagins, explained the great Rains, which fell on the Earth at the time of the Deluge, doth in the next place proceed to shew, how the waters of the Abyss were forced up to the Surface of the Earth, and became a great cause of the Universal flood. This he supposes to be performed by the vast quantity of waters, that had descended from the Comet, which, he sayes, being of a prodigious weight would press the Crust of the Earth downwards with a mighty force, and endeavour to sink it deeper into the Abyss; by this pressure the waters of the Abyss would be forced upwards through

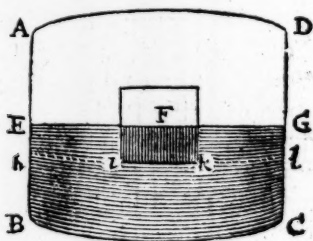
through the Cracks and Fissures newly made by the violence of the Tide on the Surface of the Earth. He endeavours to illustrate this method of Operation by the Example of a Stone or Marble Cylinder, exactly fitted to a hollow Cylindrical vessel, that it may just ascend or descend freely within it: He supposes the Stone Cylinder to have holes bored in it quite through, parallel to its Axis, and let down in the hollow Cylinder, which is half full of water, till it touch the water; then if each of the holes be filled with Oil or some other fluid lighter than water he says, that the weight of the Cylinder pressing on the water, would squeeze the Oil on its Surface through the holes, and throw it out with some violence, and this would be a just representation of the Deluge.

I must beg Mr. *Whiston's* leave to think this experiment very far from being any way a just representation of the flood, the case being very different, when the Solid is specifically heavier than the Fluid in which it is put, from what it is, when the Solid is specifically lighter than it. In the one case, the Solid would descend and force both
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Oyl and water up with a considerable force, if the holes be sufficiently small: In the other case, when the lighter Solid is put down, and swims in the fluid, neither Oyl nor Water can ascend, because the Body it self cannot descend. Now by Mr. *Whiston's* own Hypothesis, the Crust of the Earth is lighter than the Fluid in the Abyss; and therefore it is clear, that it can neither descend as the Stone Cylinder would do in water, nor force the Fluid in the Abyss to ascend, by its pressure. This will clearly appear by Mr. *Whiston's* representation a little rectified. For if instead of the Cylinder of Stone, we should take a Cylinder of Wood, which is lighter than Water, and bore it through with holes as the other was, and put it into the Water, till it swims, and afterwards pour Oyl into the holes; it is plain that neither Water nor Oyl could ever be raised to the top of the Cylinder: Nay the Water would be so far from rising higher by the additional pressure of the Oyl, that I can demonstratively prove, it would fall lower, and the Solid would not sink so far into the Water, as it did before the Oyl was put in. For

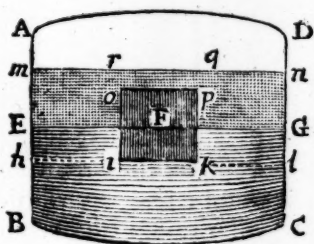
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let *A B C D* represent a Vessel half full of Water, in which *F* is a Solid swimming; it is evident, that the Solid will so far descend in the Water, till the Surface *ik* of the Water be as much pressed by the weight of the Solid, as the Surfaces *hi, kl* are by the weight of the incumbent fluid.

Now if we should pour Oyl into the same Vessel above the Water and above the Solid, as in the Figure, where *m E G n* represents Oyl; it is plain, that the Surfaces *hi, kl* are pressed with the additional Columns of Oyl *m E o r, q p G n*, which being greater than *r o p q*, the additional Oyl wherewith the Surface *ik* is pressed, will have a stronger pressure than the Surface *ik* has; and therefore



fore the Water at hi , kl , being more pressed than that which is at ik , it must descend, and force that which is at ik further up: that is, the Solid will be forced upwards, and will be so far from being heavier than 'twas in respect of the water, that it will be relatively lighter; and this must have been the true case of the Water at the Deluge. For when it fell on the Surface of the Earth, it would descend into all the Cracks and Fissures thereof, till it had quite filled them; for water cannot ly on any Surface except all the Holes and Fissures of that Surface be first filled. This adventitious water in the Fissures pressing more strongly on the Surface of the Abyss than the Water, which lay on the Sur-

face of the Crust could do, would force the Fluid immediately under it to descend, and that which is under the Crust to ascend. Thus I think, it is absolutely certain, that in this case, the water in the Abyfs would be so far from being able to ascend, that it must necessarily descend by the pressure of the incumbent water; and the whole Crust must have been raised higher, not immerg'd deeper in the Abyfs.

There is but one possible case, wherein the pressure of the water could sink the Crust deeper into the Abyfs, and that is, if the waters which lay on the Surface, could not descend through the Cracks and Fissures of the Earth. And tho I can see nothing that can hinder them from descending; yet if I should suppose, that they did not, I can evidently prove by Calculation, that such a pressure could never raise the Abyfs above the Surface of the Crust.

To demonstrate this, I assume the height of the water, which was derived from the Comet, to have been a tenth part of the thickness of the whole Crust; tho doubtless this is much greater than in reality it can be allowed to have been: and because, according to Mr.
Whiston,

Whiston, the Columns of which the Crust is composed, are about four times heavier than common water, it follows, that a Column of the same specifick gravity with the rest of the Crust, whose base is equal to the base of the incumbent Column of water, and one fourth part of its height will weigh as much, or press the Crust as much downwards as the whole Column of water could do; but the height of the water being a tenth part of the depth of the whole Crust, the height of the additional Column that weighs as much as the water, must be a fortieth part of the depth of the Crust. From hence it follows, that the height or thickness of the Crust before the additional Column is laid on, is to its thickness after the additional Column is laid on, as 40 is to 41. The whole problem then is plainly reduced to this; Having two Cylinders or Columns of the same intensive gravity, but of different heights that swim in any Fluid, to find what proportion the parts or heights immersed bear to one another. By a known proposition in Hydrostaticks, the part immersed of each Cylinder, bears the same proportion to the whole Cylinder, that the in-

tenfive gravity of the Cylinder bears to the intensive gravity of the Fluid; from thence it is evident, that the parts immersed have the same proportion that their respective whole Cylinders have to one another; which in the present case is as forty to forty one. By this it is clear, that the additional weight of the incumbent water would not sink the Crust above one fortieth part deeper into the Abyfs, than it was before; and therefore it could never rise by such a pressure so high as the Surface of the Earth. But if we should suppose that the pressure on the Crust should be so great as to press the Abyfs upwards, and the waters in it to the Surface of the Earth; it is certain, that in such a case, when the waters in the Abyfs had ascended to the Surface, there must be a communication between the Abyfs and it: by this communication, the waters on the Surface must necessarily descend and ly immediately on the Abyfs; and so the case would be reduced to the former one, where the water is supposed to press immediately on the Fluid in the Abyfs; by which pressure, the Crust would be so far from sinking deeper, that it would be raised

raised to a greater height, as I have shown before. From all this it is demonstratively evident, that by no sort of pressure of the incumbent fluid the Abyfs could be forced upwards to spread it self on the Surface of the Earth.

Another Argument, which may be urged against deriving water from Mr. *Whiston's* Abyfs, is this; He supposes the Abyfs to consist of a very dense Fluid, whose intensive gravity is greater than the gravity of the Crust which subsided into it: but this Crust being three or four times heavier than water it must be immediately contiguous to the Abyfs; so that there can be no room for any considerable quantity of water to ly between them; and therefore it is plain, that whatever water was raised from the Abyfs must be only on the Cracks and Fissures of the Earth. But Mr. *Whiston* supposes that the half of that water at least which was necessary for the Deluge was derived from the Abyfs, that is, as I shall hereafter prove, there must have been eleven times more water derived from the Abyfs than there is in the whole Ocean; which is a prodigious greater quantity than the

Cracks and Fissures can be supposed able to contain. Perhaps Mr. *Whiston* will grant, that the greatest part of what was drawn from the Abyss was not pure water, but that dense and heavy Fluid on which the Crust subsided: but if it were so, it is certain that such a Fluid being heavier than water, must have taken its place next to the Surface of the Earth, and have filled up all the pits, holes, and valleys that were on the Earth; nay it would have driven the Sea out of its Channel, and would have compleatly filled its place, where it would have remained to this day. It is most evident, that if such a thing had happened, there would have been vast quantities of that dense and heavy Fluid still abiding on the Surface of the Earth, and in pits, and holes, there being nothing to drive it from thence into the Fissures again: But yet it is evident from Observations, that there is not any such thing in Nature to be seen, and that there is no where to be found any quantity of such a dense and heavy Fluid, which Mr. *Whiston* supposes covered the Earth at the time of the Deluge. There is only a little Quick-silver which is found in
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some Mines in the very bowels of the Earth; but the quantity of it is so small and inconsiderable, that we cannot possibly suppose it to be the remains of the Fluid in the Abyfs. For if ever there had been any such Fluid on the Surface of the Earth, there must have certainly remained greater quantities of it to this day, since as I have observed before, the very Seas must have been full of it.

I freely acknowledge Mr. *Whiston's* Hypothesis about Shells, Bones, Teeth, and other *Exuvia* of Land and Sea Animals, found and dug out of the Bowels of the Earth to be very Ingenious and more Philosophical than any other Hypothesis that I have yet seen; so that to me it seems indeed probable, that the water which made the Deluge from whence soever it was derived, had in it much Mud and Earthy matter; which after the waters were gon off, settled on the Surface of the old Earth, and became a new Crust; in which these Shells, Teeth, and Bones subsided. This Hypothesis I think, doth very naturally explain all the Phenomena Dr. *Woodward* mentions in his Theory, and on that account it may be easily admitted as a true one.

I come

I come now to consider Mr. *Whiston's* way, by which he supposes all the waters, that were necessary for the Deluge, were drawn off the Earth. He imagines this to be performed partly by a wind which dried up some, and partly by the descent of the waters through the Cracks and Fissures of the Earth; to which the wind by hurrying the waters up and down would be very sufficient. Before I examine these causes, it is fit that I should make an estimate of the quantity of water, that would be necessary to cover the whole Earth above the tops of the highest Mountains. Dr. *Burnet* in his *Theory of the Earth*, reckons it to be about eight Oceans of water, supposing the Surface of the Sea to be equal to the Land, and to be every where a quarter of a Mile deep, taking one place with another. But on the same supposition, I believe, I can more exactly determine it to be near three times as much. I must here assume, that the height of the highest Mountain above the level of the Ocean, is above three Miles perpendicular height. I know *Varenius* in his *Geographia Generalis*, Calculates the height of the *Pico* in the Island of *Tenerife*,
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to be one *German* Mile, or above four *English* Miles in height: and tho I am inclined to believe, that its height is yet greater than *Varenius* makes it (for he seemes to allow too much, both for refraction and errors in the Observations;) yet because three Miles is the height, Mr. *Whiston* seemes to allow the waters at the Deluge, I will suppose the Hills no higher; and from thence I will Calculate what water would be necessary to make an Universal Deluge.


It is evident, upon such a supposition, that the waters must be raised beyond three Miles perpendicular height that they may be as high as the tops of the Hills. Now it is easy to Calculate how much water would be necessary to raise the Surface of the Sea to such an height. The Ocean being by Hypothesis a quarter of a mile deep, there are twelve such quarters in three Miles, and consequently there must not be less than twelve Oceans of water lying on the Surface of the Sea, that it may be of the same height with the water which covered the Land.

Let me in the next place suppose the whole surface of the Land thickly beset

beset with Mountains, every one of which was three Miles perpendicularly high: now because three Miles has but a very small proportion to the semi-diameter of the Earth, it is evident, that the Orb, or rather part of an Orb, consisting of waters and Mountains, would be also equal to a Cylinder, whose height is three Miles, and its base a Circle equal to the Surface of the Land. But because the Hills are supposed to be of a conical Figure, and cones by the 10th of the 12th of *Euclid*, are the third part of a Cylinder on the same base and of the same height, it is evident that the Hills would make but one third part of the former Cylinder; that is, all the Mountains if they were levelled, would raise the Surface of the Earth a mile higher than it is: from thence it follows, that the water, which lay on the Surface of the Land at the time of the Deluge, was equal to a Cylinder, whose base was equal to the Surface of the Land, and its height two miles. And because in two miles there are eight quarters of one mile, it is plain, that the water, which was necessary to cover the Land, must be equal to eight Oceans of water; which together

together with the other twelve, makes twenty Oceans of water. But because the whole Land is not so thickly covered with Hills as I have supposed, (it being indeed not possible that it should be) and because there are but few Hills so high as I have supposed them all to be, we must at least allow two Oceans more on these two accounts: so that the whole amounts to two and twenty Oceans of water, which together with the water that doth now compose the present Ocean, makes three and twenty Oceans of water, which is the least that can be necessary for an Universal Deluge. If the height of the greatest hills were four miles above the Surface of the Ocean, as most probably it is by *Varenus's* Calculation, the water, that must be required to drown the whole Earth, must be no less than twenty eight Oceans of water. But I will here suppose there was no more water, than what was required by the former supposition.

Tho it be easy for Mr. *Whiston* to suppose all this, or even a much greater quantity of water to be derived from the Atmosphere of a Comet; yet I believe he will not find it so easy a task



task to remove it again from the Earth. He himself acknowledges, that the Air could receive and sustain but very inconsiderable quantities of it in comparison of the intire Mass of waters, which then lay on the Earth. It is not possible, that this water could descend through the Cracks and Fissures of the Earth, which of necessity must have been all full at the time of the Deluge: for water cannot ly on the Surface of the Earth, till all the Cracks, Holes and Fissures in it be first filled. This is so evidently certain both to sense and experience, that I think it beyond all contadiction true; it being as impossible to make water ly on the Surface of the Earth, before all its Cracks, Pits, and Holes are filled, as it is to make a Vessel retain water, whose bottom is bored through with holes.

But tho I should suppose that the Cracks and Fissures remained empty during the Deluge (which is indeed an impossible supposition;) yet it is certain, that these Fissures could receive but little more water than what was at first derived from them. For the Crust of the Earth according to Mr. *Whiston*, lying immediately on the dense
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and heavy Abyſs, and water being lighter than it, it is abſolutely impoſſible, that ever water ſhould ſettle it ſelf between the Cruſt and the Abyſs. It is therefore clear, that no more water could deſcend through the Cracks and Fiſſures of the Earth than what they were able to contain, or what had firſt aſcended through them to the ſurface of the Earth; which Mr. *Whiſton* ſuppoſes to be half the water neceſſary for making the Deluge, and muſt be according to the former Calculation, at leaſt eleven Oceans of water: Tho indeed I cannot eaſily underſtand, how 'tis poſſible for them to contain and receive ſo much. What then can we imagin would become of the reſt? for after that the Channel of the Sea was compleatly filled, there would remain eleven Oceans more to be diſpoſed of; which there is no imaginable place in the Earth able to receive. And therefore it is clear even to a demonſtration, that all this water could never be removed by natural means.

THESE are the chief and moſt ſubſtantial points I have conſidered in Mr. *Whiſton's New Theory*; I might have made ſeveral

several objections against other parts of it, and particularly I might have taken notice of some mistakes he has made in Geometry; but because the Truth of his Theory doth not depend upon them, I have passed them over. If Mr. *Whiston* will be pleased to make any answer to the Objections, I have here made; I would desire of him, that, whatsoever difficulties he designs to remove, he will do it by clear and distinct reasoning from Mechanical Principles. If he find himself pressed with any objection, which he cannot answer, I doubt not, but that he will have the Ingenuity to own it. I know there are some Philosophers, that never miss to tell their Readers, they reason clearly and distinctly, when no body else can discover the consequence but themselves. And when they are sore pressed with any difficulty, they make a long discourse about some thing the Reader knows not what, and endeavour to get off in a mist of words; but I expect no such dealing from one of Mr. *Whiston's* Candor and Sincerity.

F I N I S

